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A series of five experiments was designed and administered to 679 elementary and junior high school students over a 2-year period to test the relevance of Jean Piaget's concept of conservation to musical learning. Musical tasks consisting of stimulus patterns and systematic variations of these patterns were designed for each experiment, and experimental settings for individual experiments were varied. Results indicated (1) task performance progressively improved from younger to older age groups; (2) improvement in conservation of tonal patterns preceded improvement in conservation of rhythm patterns; (3) training to enhance conservation was most effective at ages 5 and 7; (4) change of mode, contour, and rhythm pattern interfered with conservation more than change of instrument, tempo, or the addition of harmony; (5) a plateau in music conservation skills was reached in the fourth grade; (6) patterns in minor mode produced better rhythm conservation than major or atonal patterns; (7) the initial teaching of musical structure may best be pursued through the study of familiar music. The presence of visuals in one experiment made a significant difference in the results. The conclusions emphasize the importance of an early acquaintance with basic music structure and vocabulary and the need for instruction to decenter perception from the biasing aspects of music by a consideration of musical variations. (Author/LH)

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Cooperative Research Project No. 5-0256

Marilyn Pflederer Zimmerman
Lee Sechrest

NORTHWESTERN UNIVERSITY
EVANSTON, ILLINOIS
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How Children Conceptually Organize Musical Sounds

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August, 1968

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CHAPTER I

SUMMARY

The purpose of this project is to test the relevance of one aspect of Jean Piaget's theory of concept development, that of the principle of conservation, to musical growth and development. The problem around which the project centers is to identify conservation and to examine its function in the development of musical concepts. Thus, this project is concerned with the rational aspects of musical development. These rational aspects consist of the intellectual controls of operational thought, marked by the emergence and utilization of conservation, pointed to by Piaget in his researches into children's development of concepts of quantity, weight, volume, and class inclusion.

Objectives

The specific objectives of the study are as follows:

1. To refine evaluative tools with which to study conservation in perceptual tasks based upon tone and rhythm.
2. To identify the relationship between decentration and conservation in perceptual tasks based upon aural stimuli. As a child is able to decenter his perception from dominating aspects of the musical configuration, conservation should be facilitated.
3. To determine whether aural perception and tonal memory can be separated from conservation in tasks based upon aural stimuli.
4. To determine whether or not a child has to be at a certain level in Piaget's developmental sequence before training will help the decentration process which leads to conservation.

A dominant theme in music education literature today is that the underlying musical structure, comprised of the basic elements of melody, rhythm, harmony, and form, must be taught to students. And so we read and hear much about teaching melodic, rhythmic, harmonic, and formal concepts to our students.

Piaget views concept development in terms of conservation, the invariance of a particular concept in the child's thinking even though changes occur in its presentation. Conservation is justified by the properties of reversibility and compensation. Instabilities and biases in perception are offset by the ability to make inferences and to manipulate the arithmetical operations of addition, multiplication, division, and subtraction. Piaget refers to this as operational thought.

In his recent work Piaget has considered the question of qualitative invariants which do not require a quantitative composition of parts as does true conservation. This phenomenon Piaget calls "qualitative identity." In a qualitative identity the permanent quality is simply dissociated from the variable qualities. These qualities, color, shape, pitch, are identified through perception. We believe that Piaget's notion of qualitative identities or invariants has particular relevance for our researches.

A clarification of the two terms shows that a true conservation is possible only when there is a composition of quantitative variations. This can take the form of a compensation of relations or simply of an additive composition of parts. A musical example would be conservation of meter. Here the length of measures within the measures may vary. Reversibility of thought enables an individual to rationalize the component beats, to conserve the meter, and to understand its function.

Perception is directed toward the invariant properties of and relations among things perceived. The term "qualitative invariant" refers to perceptual constancies such as color, shape, and pitch. When an individual identifies the rectangular shape of objects as the invariant quality even though their size and color vary, he has made a qualitative identity. Similarly, when he can abstract identical pitch patterns from varying rhythms, he has also made a qualitative identification.

A consideration of the development of musical concepts raises a fundamental question as to the role of perception and the intellectual processes in musical learning. In a temporal structure such as music it is highly possible that conservation laws operate on a more concrete level than in the quasi-mathematical structures with which Piaget concerned himself. Music consists of an organization of tonal relationships within a temporal structure. For music to be apprehended, understood, and performed there are concepts pertaining to the relationships of melody, rhythm, harmony, and form that must be learned. Musical learning begins with perception of the sound structure; from this perception develop those relational concepts which permit one to think about what has been heard.

One factor in intelligence is the ability to perceive and invent relationships. We believe that musical intelligence is based not only upon the perception of the particular effects of musical relationships, but also upon an understanding of the relational processes from which they derive. This we believe to be a kind of conservation process. Hence, the essence of musical intelligence is found in the conceptual framework of rhythmic, melodic, harmonic, and formal relationships which has developed through a progressive organization of musical perceptions.

Five conservation laws undergird the stability of operational thought in Piaget's theory: combinativity, reversibility, associativity, identity, and tautology or iteration. The rationale upon which this research is based is that five "conservation-type" laws can be identified in the development of musical concepts. We have defined these conservation laws as follows: identity, metrical groupings, augmentation and diminution, transposition, and inversion.

Five experiments were designed and administered to over 600 subjects during the course of the project to collect in experimental settings data that bear upon these notions in musical perception and learning.

Experiment I

Six musical tasks were devised to study the relationship between decentration and conservation as evidenced by the ability to conserve duration, meter, tonal patterns, and rhythm patterns. Each of the tasks required a foil representing the change or deformation made in the shape of presentation of the specific property to test the subject's ability to conserve it. The tasks were administered individually to eighty subjects distributed over four age levels, five, seven, nine, and thirteen and involving four grade levels, kindergarten, second, fourth, and junior high. The number of boys and girls at each level was equal.

The quantitative data resulting from the first experiment consist of scores for each subject on each of the six tasks. On Tasks I, II, and IV the score was simply the number of correct responses, but on Tasks III, V, and VI the score was "corrected" for any failure of a child to identify correctly an exact repetition of the original stimulus, thus correcting to some degree for faulty memory.

For all but one of the tasks there was progressively better performance from the younger to the older age groups. For the most part this progression was close to being linear; there was no evidence for any "stages" in the development of the musical concepts tapped in this experiment. Tasks V and VI, involving conservation of tonal patterns, show some departure from linearity at the upper end of the age distribution, there being very little improvement after age nine. The improvement on these two tasks between five and seven years is much greater than the improvement on Task III, which deals with conservation of rhythm pattern. Evidently improvement in conservation of tonal pattern precedes improvement in conservation of rhythm pattern.

Experiment II

Experiment II was designed with a two-fold purpose: (1) to refine the instrument used in Experiment I and (2) to determine the efficacy of training to enhance conservation in a classical experimental and control design in which brief training sessions are run in small groups of three or four children. Four musical tasks were devised. These tasks consisted of four phrases selected from Bartòk's piano music, For Children, in which systematic deformations were made in order to test for the presence of conservation. Each deformation was paired with each original phrase. The age groups and grade levels were again the same as in Experiment I. The only criterion for selection was that the subjects had had no private music instruction. The subjects were randomly assigned to experimental and control training groups, followed by individual testing sessions.

The data consist of the responses of the subjects to the question whether the various deformations were the same or different from the standard stimulus. The three possible categories of responses were that the two stimuli were the same, that they were different, or that they were both the same and different. The latter category is critical for the experiment, for if the experimental treatment had any effect, then it would be expected that the subjects exposed to it would be more likely to note both similarities and differences.

The data bear out the expectations concerning the efficacy of the experimental treatment. At the five- seven- and nine-year-old levels the experimental subjects produce a higher frequency of "same and different" responses, with the effect being most marked at the five-year level and least at the nine-year level. Hence, relatively greater benefit is produced by early introduction of the experimental training. At the thirteen-year level there is no longer any evidence for any effect of the experimental treatment.

Type of deformation or variation is also highly significant. Change of instrument, the addition of harmony, and tempo change were "easy" for our subjects in the sense that they permitted a subject to hear that some change had been made and at the same time maintain or "conserve" the invariant quality of the tonal pattern itself. The different variations did not differ greatly in the degree to which they separated the age groups.

Experiment III

Experiment III was an attempt to extend this type of investigation by using more educationally relevant teaching periods. Kindergarten, second, fourth, and eighth graders were randomly assigned to experimental and control training sessions. Each group had the equivalent of six 20-minute classes of instruction over a two-week period. The experimental subjects were exposed to instruction designed to elicit the invariant qualities from songs in which variations had been made. The control group subjects were exposed to more traditional instruction which incorporated the song bells and piano chording.

After the training sessions each subject met with an experimenter in individual 30-minute testing sessions. The musical tasks consisted of four familiar songs in which systematic variations had been made. The subjects responded to the tasks by manipulating a key press mechanism. In the first two experiments the subjects responded verbally. The response mechanism was designed to eliminate the necessity for verbal replies and so to negate age differences in the ability to verbalize. The subject was required to press one button when certain critical variations, e.g., the addition of harmony or change of mode, occurred and a second button only when completely different music was heard. The experimenter marked on score sheets when the buttons were pressed according to a second timer. Each subject was given a score based on two points for a correct response, one point for a partially correct response, and no points for a completely wrong response.

Analysis of the data showed that children at different grade levels differed markedly in their performances, with the most marked change occurring between the kindergarten and second grade levels. There was no significant difference associated with experimental treatment. The interaction between age and songs was highly significant. The deformations also differed in difficulty although the differences were surprisingly small. Mode proved to be the easiest for our subjects and transposition was the most difficult.

Experiment IV

Experiment IV was designed to study the effects of combined deformations on tonal conservation. The musical tasks consisted of combined deformations or variations in the four familiar songs used in Experiment III.

Eighty subjects drawn from second, third, fourth, and fifth grade students were randomly assigned to one of two conditions, ten subjects from each grade level to each condition. Again the subjects responded individually to the tasks by manipulating a key press mechanism. Those in Condition I pressed a black key for a variation, a white key for completely different music, and no key for the original music. Condition II subjects pressed the black key only when completely different music was heard.

The data for this experiment did not show a significant age difference. Across age levels there was a significant difference between Conditions, with Condition II subjects performing significantly better than Condition I subjects. Again differences in difficulty levels between the combined deformations were small. Instrument and harmony was the easiest double deformation for our subjects; rhythm and inversion was the most difficult.

Experiment V

Experiment V was an attempt to compare tonal and rhythm conservation by administering a paper-pencil test to small groups of subjects. Brief musical phrases were prepared. These consisted of six different tonal patterns and six different rhythm patterns. For the tonal conservation task each pattern (three major, two minor, and two atonal) was deformed by changing the rhythm and four items were available for each pattern, twenty-four in all. For the rhythmic conservation task each basic rhythm pattern was presented in the context of major, minor, and atonal patterns. Again there were twenty-four items.

The music was recorded on tape with the piano as the instrument, and answer sheets were prepared. Half of the answer sheets had visual representations of each original stimulus. For tonal pattern more or less conventional notation was used with darkened ovals placed on a five line staff. Rhythm was presented visually by horizontal lines of varying length. At each of four grade levels, second, third, fourth, and fifth, 20 children were tested with and without the visuals, a total of 160 children in all.

Results showed that third graders were significantly better than second graders; that fourth graders were significantly better than third graders, but that there was no significant superiority of fifth graders over fourth graders. There was a significant difference attributable to the presence of visuals with the effect being greater for those subjects who received the rhythm tasks first. The patterns in minor mode produced better rhythm conservation than the major or atonal patterns.

Implications

Implications from our series of experiments point toward the importance and necessity for an early acquaintance with the basic structure and vocabulary of music. Instruction designed to decenter perception from biasing aspects of the music by a consideration of musical variations can be effective.

CHAPTER II

INTRODUCTION

A dominant theme in music education literature today is that the structural concepts of music must be taught to children. Indeed, one of the major objectives of the elementary music program is to enhance the musical learning of children through a sequential presentation of musical concepts. Yet with the exception of the Andrews and Diehl Research Project (1), research into the formation of musical concepts has been almost non-existent. Most of the research that has been conducted has been in the dual areas of auditory perception and auditory recall, with measures being devised to determine children's abilities to discriminate between pitches, intensity, and durational values, and to remember tonal patterns. There is little evidence of research designed to trace the development of musical thought.

A secondary theme in music education literature today is that music teaching must be based on sound psychological principles of learning. Curriculum reformers and revisionists stress the need for structural elements and unifying concepts of music to be translated into terms which children at various age levels can understand and assimilate. Again there is little evidence of experimental research in the application of developmental psychological theories to musical learning. The present research project is an attempt to develop further each of these themes through a series of experimental studies.

The research of Jean Piaget presents a graphic description of how children build a structural framework of concepts enabling them to interpret the world in which they find themselves. Although Piaget is not much affected by the "growing vogue for rigorous theories, with precise statement of assumptions, derivation of predictions and operational definition of concepts" (2), his monumental researches into the development of behavioral and thought structures from infancy to adolescence have caused no little stir among developmental and educational psychologists.

Piaget's method is the intensive study of a few cases rather than the statistical investigation of a few traits in a large population. Mays believes that Piaget's work should be regarded as a "pilot study" and that further work needs to be done." Mays writes, "He (Piaget) has at least traced out the lines of investigation on which we should proceed if we wish to obtain a picture of child thought" (3, p. 22).

The purpose of this project is to test the relevance of one aspect of Jean Piaget's theory of concept development, namely that of the principle of conservation, to musical growth and development. The problem around which the project centers is to identify conservation and to examine its function in the development of musical concepts.

A musical experience has many facets. It can be emotional, aesthetic, perceptual, or intellectual, that is to say, conceptually mediated. Hence, musical development has many facets. This project is concerned with the rational aspects of musical development. These rational aspects consist of the intellectual controls of operational thought, marked by the emergence and use of conservation pointed to by Piaget in his researches into children's development of concepts of quantity, weight, volume, and class inclusion.

The specific objectives of the study are as follows:

1. To refine evaluative tools with which to study conservation in perceptual tasks based upon tone and rhythm.
2. To identify the relationship between decentration and conservation in perceptual tasks based upon aural stimuli. As a child is able to decenter his perception from dominating aspects of the musical configuration, conservation should be facilitated.
3. To determine whether aural perception and tonal memory can be separated from conservation in tasks based upon aural stimuli.
4. To determine whether or not a child has to be at a certain level in Piaget's developmental sequence before training will help the decentration process which leads to conservation.

The relationship which exists between perception and concept formation is a very real one. A concept is a clear and complete thought, a mental image, about something that has been acquired through sensory perception. The interdependence of percept and concept is especially evident in musical learning. It seems almost a truism to say that musical learning begins with perception of music. From our various perceptions of music develop musical concepts which permit us to think about what we have heard and which provide us with a basis for communicating our musical ideas through performance and at the symbolic level of notation. Thus, the musical learning process moves back and forth through three phases, from the perception of tonal-rhythmic relationships to the mediation of these relationships into meaningful concepts to the representation of these relationships at the symbolic level.

In perceptual learning one surveys the perceptual field, selects relevant from irrelevant material and makes judgments concerning the material selected. Young children and older beginners in music have a tendency to fixate their perception on a dominant or biasing aspect of the music. This tendency, known as "centration," results in an inaccurate and incomplete survey of the total musical configuration, be it vocal or instrumental. For example, a trumpet melody may so capture the focal point of a child's perceptual attention that any other information about the music is excluded from his ears. A dominating melodic line in the soprano often has a magnetic attraction for the other singers, regardless of the part they are supposed to be singing. As children are able to decenter their perception, i.e., explore other aspects of what they are hearing, they receive more complete and undistorted information about the music, information from which to derive musical concepts.

The present project is designed to discover how a child organizes conceptually the musical sounds that he hears. First, by examining the decentration process and conservation in musical development, a more efficient way of presenting musical concepts to children could be indicated. Second, the study could determine when in the developmental process, a certain type of musical experience would produce the maximum amount of growth. Third, the study could produce a unique instrument for determining sensitivity to tonal and rhythmic patterns.

Learning music in the elementary school, in particular, involves teaching for decentration. All aspects of the music must be brought into perceptual focus for the children and clarified so that they can form concepts about what they are hearing and/or performing. This means that although music is a unit of tone and rhythm, the various elements of a composition need to be isolated for teaching purposes.

There is a definite need for music educators to organize the elementary music curriculum in a sequence of learnings. This sequence should be based upon knowledge of the intellectual and musical capabilities of children at various ages. In too many instances the curriculum has been a haphazard mixture of facts and songs which do not challenge and stimulate either the musical or intellectual growth of students. Research can point the way to a better matching of curriculum to child.

Measures to determine musical sensitivity that have, at the same time, classroom application would greatly benefit elementary music study. It is our hope that this research project will be an aid in the exploration of these exciting possibilities.

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Chapter III

PIAGET'S CONSERVATION LAWS AND MUSICAL CONCEPTS

The purpose of this chapter is to discuss the conservation lasw underlying Piaget's psychology of intelligence and to propose analogous "conservation" laws which operate in the development of musical intelligence. A brief summary of Piaget's genetic theory of intelligence will clarify his use of the principle of conservation in the intellectual process. In Piaget's theory intellectual processes have their roots in sensori-motor behavior. During the first eighteen months of a child's life his activities are related to immediate perceptions of his surroundings. These perceptually-dominated activities provide the infant with the requisite raw materials for forming concepts about his world. Through his sensori-motor activities inchoate notions of space, time and causality emerge. As the child interacts with objects, he comes to realize that objects exist even when out of sight. This realization helps him to construct an initial invariant, e.g., the concept of the permanence of an object.

Piaget designates the second period in the intellectual development of the child as the preoperational representation stage. This period begins at about eighteen months or two years of age and lasts until the child is seven or eight. There are two phases within the preoperational stage: the preconceptual and the intuitive phases. Throughout this period the child's thought is dependent upon his perceptions. During the preconceptual phase the child's perception is centered on only one aspect of the stimulus field at a time so that he has no basis for coordinating relationships. Rather he reasons transductively, from particular event to particular event or from perception to perception. Transductive reasoning becomes a form of argument by analogy: because A is like B in one respect, A and B must be alike in all respects. As the child experiences failure in the confirmation of his transductions, he begins to develop intuitive regulations that correct his perceptions and mediate the formation of categories.

Perception, according to Piaget's theory, plays a paramount role in the child's thinking during the intuitive phase of preoperational thought which he has identified in children, ages four to seven. At this level the child's thought is fixated upon dominant elements or aspects of the perceptual field. Piaget refers to this perceptual fixation as "centration." The propensity to "center" upon the dominant, to over-estimate the immediate, has the concomitant effect of disregard for other aspects of the stimulus situation, and systematic distortions in perception result. For this reason perceptual thought suffers from certain instabilities which conceptual thinking is later able to transcend. Perceptions also differ from one individual to another and from moment to moment within the same individual. Hence, a world represented only by one's perceptions changes with the location of the individual and with the direction of his attention within a particular location. Through the development of perceptual activities distortions in perception and instabilities of perceptual thought are gradually, but increasingly, offset by "decentrations" which result from a more mobile and effective exploration of the total stimulus field.

> Transition from a single centring to two successive centrings heralds the beginning of the operation; once he reasons with respect to both (two) relations at the same time, the child will in fact, deduce conservation (15, p. 131).

Deliberate and systematic variations in the focus of attention allow information to be processed from a succession of fixations, and more objective impressions of reality are formed. This development of perceptual activity takes it to the threshold of operational thought. By means of comparisons and transpositions, perceptual activities and regulations tend towards reversibility and so pave the way for the operation by introducing more and more mobility into the sensori-motor schemata that constitute its substructure. Thus, the development of perceptual activities mitigates imperfections in thinking contaminated by the shortcomings of perception and lead toward a transformation of perceptual experience into concepts.

Operational thought structures are formed at about age seven when the basic stock of concepts formed at the preoperational level are organized into coherent systems. These intuitive regulations undergirding operational thought are internalized responses that have grown out of overt actions. An operation is simply an internalized action, an action that has been carried out in thought. At this stage the child's thought is no longer tied to his perceptual activities for he is able to "decenter" his thought from his perceptions. Although the child is able to reverse processes and to grasp relationships between more than two objects at a time, his thought is dependent upon the existence of a concrete framework.

The stage of formal operations, ages twelve to fifteen, marks the development of the child's ability to use the hypothetico-deductive procedures of science and logic. The individual at the stage of formal thought begins by reasoning about theoretical possibilities. From these hypotheses he proceeds to the empirical data. "The reversibility of logical thought is acclaimed by Piaget as the acme in which the growth of intelligence culminates.... A thought can be entertained and then unthought, and everything is as if it had never occurred (2). Thus, through the reversibility of logical thought an individual is able to conceive possible solutions for problems which would perhaps be costly, dangerous, or even impossible to test by action. Piaget uses the terms of symbolic logic to describe the processes involved in formal operational thought.

Piaget's idea of the reversible operation, a definitive characteristic of mature thought, is the keystone of his theory. According to Piaget, reversibility is essential to any form of mental experimentation and to logical inference. The reversible operation is at the heart of the principle of conservation. Conservation refers to the invariance of a particular dimension of empirical objects throughout observed changes of state. It results from operational reversibility.

Piaget views concept development in terms of conservation, marked by an increasing stability of a particular concept in the face of changes (often irrelevant) in the stimulus field. Conservation is justified by the properties of reversibility and compensation. Conservation deals with quantitative invariants and occurs only when a compensation of relations or additive composition is involved. When a child is able to return to the initial state of a given material by an inverse operation, he exhibits reversibility of thought and so affirms the conservation of that material. Operational thought consists of a system of balancing interchanges which allows the child to reason that changes in one direction will be compensated for by changes in the other. When he can reason that a change in the length of a given material will call for a corresponding change in its width to compensate for the elongation, he also exhibits conservation. A variety of experiments enabled Piaget to trace the development of conservation from a stage of non-conservation at the beginning of intuitive thought through a transitional stage to conservation at the concrete operations level (17).

In his more recent work, Piaget has considered the question of qualitative invariants where there is no quantitative composition. This phenomenon, which Piaget calls qualitative identity, has its origin in the latter phase of the sensori-motor stage of development. In a qualitative invariant there is simply a dissociation between a permanent quality and the variable qualities, but "there is no (quantitative) composition of these variations (14)." These qualities, color, shape, pitch, are identified through perception. Piaget's notion of qualitative identities or invariants has particular relevance for the study of music concept formation since the quality of pitch is apprehended through perception.

Piaget has identified four levels in the development of identity: (1) identity is not questioned and is based essentially on the assimilation of an object to the child's own action patterns (age 3 or 4); (2) interest is taken in the object itself; if an object changes its form, it may not be the same (age 4 or 5); (3) permanent qualities can be dissociated from variable qualities; object remains the same even though it has changed its shape (ages 5-7); and (4) conservation as well as qualitative identity is attained; early identity is integrated into the operational system and can take the form of the identical operation (age 7 or 8).

Conservation Laws (16)

We have alluded to the fact that Piaget uses logic as an external frame of reference for studying the learning process. Since both mathematics and logic use terms and symbols reflecting actions, Piaget (15, pp. 40-42) asserts that the operations of logic and mathematics correspond to overt actions from which emerge the operations of thought. Stability of operational thought is dependent upon five conservation laws: (1) combinativity in which any two classes may be combined into one comprehensive class that includes both; (2) reversibility in which any given mathematical or logical operation can be cancelled by its inverse operation; (3) associativity which allows for the combination of several operations without regard for any particular sequence of combination; and (4) identity wherein any operation can be nullified by combining it with its opposite operation. The fifth property has two versions, one for logical classes and relations, the other for numbers. Tautology holds for logical classes: a classification or relation which is repeated is not changed. In considering numbers, iteration refers to the fact that a number combined with itself produces a new number.

At the concrete level the child can handle only the logical operations of elementary groupings of classes and relations which are characterized by two forms of reversibility: negation, in which a perceived change in form is cancelled by its corresponding negative thought operation, and reciprocity. The skill with which a child can deal with problems involving the application of physical principles is in part determined by the elegance and advance of his comprehension of these forms of reversibility. However, the two forms of reversibility are still used independently of one another at the concrete level; in formal thought they will form one unified system of operations.

Musical Aptitude

A discussion of musical learning presupposes basic assumptions about the nature and functioning of what Mursell(13) termed "the musical mind." Musical aptitude tests have attempted to measure the abilities that constitute the musical mind. A variety of these musical aptitude tests have been reviewed in an effort to ascertain whether or not researchers have attempted to identify the nature of the thought processes involved in making the required judgments. Mainwaring (12) seems to be the only researcher who attempted to do this.

A short summary of eight representative musical aptitude tests is included here in order to provide further background for the present study. The tests reviewed fall into two main classifications: atomistic and musical. Those that are atomistic in nature might be described as acoustic-psychological, while the latter are of a musical-psychological nature. A prototype of the atomistic is the Seashore battery (1919) (18), comprised of six different measures--pitch, loudness, rhythm, time, timbre and tonal memory. The pitch test consists of 50 pairs of tones reduced to their most elemental form in that the tones, produced by a beat-frequency oscillator, are free from harmonics while intensity, timbre and time relationships are held constant. The subject is simply requested to indicate whether the second of the two successive pure tones is lower or higher than the first one. In the rhythm test the subject is asked to state whether two time patterns are the same or different. From this short summary of two of the measures it would appear that the Seashore battery merely presents a mosaic of an individual's capabilities in auditory perception. Five of the remaining seven tests to be briefly summarized contain portions that are both atomistic and musical; the Franklin Tonal Musical Talent Test (5) and the Gordon Musical Aptitude Profile (7) can be classified as musical.

The Kwalwasser-Dykema test battery (1930) (9) contains ten tests--tonal memory, quality discrimination, intensity discrimination, tonal movement, time discrimination, rhythm discrimination, pitch discrimination, melodic taste, pitch imagery and rhythm imagery. Portions of this battery are more musical than are those of the Seashore. The tonal memory test is based on tonal melodies while the tests of tonal movement and melodic taste are also presented in a musical setting. However, these tests are for older subjects who have had some music experience. That this observation is a valid one can be substantiated by the melodic taste test which measures the listener's sensitivity to phrase balance and structure. Each item consists of a two-phrase melody wherein two alternatives are given for the second phrase. The subject makes a value judgment as to which of the two second phrases better complements the first on the basis of congruity and compatibility.

In 1931 Mainwaring devised three test series, one avowed purpose of which was to analyze the cognitive processes involved in musical ability into their specific factors. Accordingly, the test series consists of the eduction of pitch difference, the eduction of rhythmic pattern and the recall of auditory experience. The underlying assumption of the Mainwaring tests is that music is a matter of relationships and that as such a rhythmic pattern is unaffected by the absolute speed of the whole rhythmic group and a given melody is recognized whether played on the piccolo or bassoon. This assumption sounds much like Piaget's principle of the conservation of the whole as long as the logical relationships within that whole are maintained.

Mainwaring's rhythm tests consist of determining the meter of sounds produced by taps, of sounds produced by a buzzer and of rhythmic word groups. After administering the tests in four experimental situations, Mainwaring concluded that the cognitive process involved in rhythmic perception is "not merely the eduction of a spatial or temporal relation between two given fundaments, but involves also the building up of a number of such relations into a concept of symmetry and pattern (12, p. 185)."

Drake's Four New Tests of Musical Talent (1933) (3) consist of a musical memory test, interval discrimination, retentivity of melodic elements and a test of intuition. The intuition test is analogous to the melodic taste test of the Kwalwasser-Dykema battery. In the musical memory test the subject is asked to listen carefully to the first melody in each of 12 pairs. The first melody is followed by a second and the subject has to indicate if the two are the same, if the second has been transposed to a different key, if the time has been changed or if any notes have been changed.

Lundin (1943-44) (10) constructed five tests to measure in an "objective fashion" musical behavior not measured by other tests. The five tests include interval discrimination, melodic transposition, mode discrimination, melodic sequences and rhythmic discrimination. In the latter two tests the subject is asked to make a judgment as to whether or not the last of four groups of notes follows either the same melodic sequence or rhythm pattern as do the first three groups. This procedure gives the individual some experience with the pattern before he is asked to make a judgment.

Wing's Tests of Musical Intelligence (21) were standardized in the early 1950's. The initial purpose of the tests was to select students of high musical aptitude for the study of instrumental music. The test battery is composed of the following tests, chord analysis (detecting the number of notes played in a single chord); memory (detecting a change of note in a short melody); pitch change (detecting a change of a single note in a repeated chord); rhythmic accent (choosing the better rhythmic accent in two performances of the same piece); harmony (judging the more appropriate phrasing in two performances of the same piece). Elementary students take only the first three sections of the test.

In a test designed to identify tonal musical talent, Franklin (1956) (5) presented subjects with short melodies, interrupted immediately prior to the final tone. They were asked to supply the final tone either by singing, humming or whistling. Franklin hypothesized that an individual is musical if he responds to the tonal motion of a melodic phrase and that this can be measured by asking the individual to supply the missing tonic. The hypothesis of this test fails to consider that contemporary music which is not restricted to the tonal system.

A Musical Aptitude Profile developed by Edwin Gordon (1965) (7) measures ability in tonal imagery, melody and harmony; rhythm imagery, tempo and meter; and musical sensitivity, phrasing, balance and style.

Musical Intelligence

A consideration of the development of musical intelligence raises a fundamental question as to the role of the intellectual processes in musical learning. In his work Piaget deals with quasi-mathematical structures and, hence, with quasi-mathematical invariances. Other invariances, such as those of color and pitch, are found in perceptual structures.

Ernst Mach (11) a forerunner of Gestalt psychology theorized in his book, The Analysis of Sensations (1886), that changes in spatial and temporal orientation did not bring about a radical change in the experience of the over-all configuration. A rectangle remains a rectangle even though its size or color may vary. Similarly, a series of tones learned at one tempo is recognizable when played at a slower or faster tempo (20).

Although Piaget seems to make a strict line of demarcation between a percept and a concept, it is probably untenable and maybe impossible to set up this strict line in a musical structure. Music consists of an organization of tonal relationships within a temporal structure. For music to be apprehended and understood there are concepts of melodic, rhythmic, harmonic, and formal relationships that must be learned. Musical learning begins with perception of the sound structure; from this perception develop those musical concepts which permit one to think about what has been heard. In a temporal structure such as music it is highly possible that conservation laws operate on a more concrete level than in quasi-mathematical structures. Even in Piaget's early experiments we often find the older child in particular combining the conceptual with the perceptual, as when conservation of a material is a part of his immediate perception of it. (It is here that the notion of qualitative identity may be particularly applicable.)

In Piaget's account of the development of concepts of quantity, time and space in the child the principle of conservation is of singular importance. The essence of musical intelligence is found in the conceptual framework of rhythmic, melodic, harmonic and formal relationships which has developed through a progressive organization of musical experiences. It is this conceptual musical framework that permits an individual to think about what he has heard. Within the context of Piaget's theory musical intelligence can be assumed to be a superior form of musical organization, represented by an equilibrium of cognitive structurings of musical elements that is built up through a utilization of the principle of conservation (17, p. 255).

La Perception de la Musique by R. Francès contains much material that is germane to the present study. The project has made it possible to have relevant portions of this book translated into English.[1] In his book Francès examines his theories of musical rhetoric, musical syntax and musical discourse and the results of experimental studies designed to test these theories (4).

[1] A longer excerpt from Francès' work, La Perception de la Musique has been translated and is presented in Appendix A.

According to Francès, since intelligence is the ability to invent and perceive relationships, it is evident that tonal interpretation is of an intellectual order. Intelligence in musical perception must be sought at the level of the comprehension of the total structure and in the uses of groups of musical transformations.... But perception of a relationship must not be confused with perceptive comparison. Truly, it is in the analysis of vision that these distinctions have been made, but it is evident that they could apply equally in hearing: the elements of the same figure could be comprehended in the perception of a relationship, or if these elements are too far away from one another in time and space, they may become the objects of a perceptive comparison. In this case, one has a single "centration," followed by a "decentration," then "a coordination of centrations (that is) bound to an ensemble of elements as opposed to particular centrations (p. 102)."

Operative musical concepts designate types of transformations of structures which have perceptible effects, transformations which are based on definite types of relationships: transposition, modulation, variation, imitation (p. 209). We believe that musical intelligence is based not only upon the perception of the particular effects of these transformations, but also upon an understanding of the relational processes from which they derive.

As we have seen, five conservation laws undergird the stability of operational thought in Piaget's theory; combinativity, reversibility, associativity, identity and tautology or iteration. The writers would like to suggest that five "conservation" type laws might possibly be identified in the development of musical concepts. These conservation laws are as follows: identity, metrical groupings, augmentation and diminution, transposition, and inversion.

1. Identity. Identity when applied to thematic material refers to the maintenance of its essential characteristics. The identity of a theme allows one to recognize repetitions of it when the theme is played by different instruments or when it is treated sequentially. In a sense, this is a qualitative identity for the permanent qualities of the theme are dissociated or abstracted from its variable qualities. By traveling back in thought to the initial statement of the theme, one can identify unfolding sound patterns as repetitions or sequences of previously heard material. Another example would be the identification of a return to the basic tonality after modulations from it.

These acts of "perceptive comparison" seem to presuppose an active intelligence in the sense that a reversible mental operation covers the intermediate sound area in order to arrive at an identification.

> The comprehension of a deferred repetition, characteristic of thematic composition, seems to us the elementary step to musical intelligence in that it implies reversibility, the imaginary return to a previous moment from a certain point which recalls it. It is equivalent to a simple arithmetical or geometric identification stemming from elements dispersed in the figure or in the data of a problem....
>
> The work of thought....is always to bring together identical or equivalent forms or signs by going through more or less numerous mediations.... To discover the partial identity of a theme under the counterpoints which hide it or to discover a triangle in a figure where it is hidden by other lines are cases in point.... Again, the comprehension of a relationship always presupposes the superseding of the data either by the choice of essential traits in an ensemble or by the privileged attention given to one ensemble over the others....
>
> (4, pp. 151-152)

2. Metrical Groupings. "Rhythm favors perception by grouping (19)," and accent gives the impression of grouping. Any rhythmic stimulus, whether tonal or visual, is perceived as a constellation about an accented element. According to Mursell, "a rhythmic unit grouping contains one and only one strong or accented element (13)." As these accents influence the non-accented members of the rhythmic stimulus series, they cause a perception of definite relationships within the rhythmic grouping. Hence, for the listener rhythm represents an active organization of the tonal stimuli about an accent. While the psychological factor of rhythm is independent of the qualitative content of the stimulus series (the specific tonal or visual content), it is dependent upon accentuation, duration and distribution in time.

A major aspect of musical intelligence is the ability to conserve the meter. Once the temporal unit has become invariant in the child's thinking, other rhythmic concepts can be assimilated to it. From this basic structural concept of meter stem the schemata for relational reasoning in the temporal aspects of music. The temporal unit of a measure in a specific meter stands as something constant; the duration within that measure is subdivided. The reversible operation is used when an individual is able to maintain a meter even though the duration of particular note values varies within the measures, and when he is able to discriminate between different meters. Here we have a true conservation since quantitative transformations are involved.

3. Augmentation and Diminution. Two characteristic "conservation" principles operant in a musical structure are the reciprocal rhythmic devices of augmentation and diminution. The Harvard Dictionary of Music defines these devices as follows: "Presentation of a musical subject in doubled (augmentation) and in halved (diminution) values, e.g., with the quarter note replaced by a half note or an eighth note respectively." (1, p. 62) Reversibility of thought plays a definite role in these two devices. Before an individual can make the time judgment that a given melody has been played twice as fast or twice as slow as when he first heard it, he has to be able to travel back in thought to a different representation of the unit beat, e.g., the quarter note. This kind of time judgment requires a relational framework based upon the reversible operation which, as we have seen, is a definitive characteristic of mature thought.

4. Transposition. A melody remains invariant (the same qua melody) when it is transposed to a new key if its intervallic relationships are maintained. This invariance of tonal organization was used by von Ehrenfels in defining "Gestaltqualitätion" and in formulating the laws of gestalt psychology. The invariance of melody under conditions of transposition led Ehrenfels to declare "that in this fashion, shape and temporal form are clearly established as phenomena sui generis"(8, p. 118)

Within the literature dealing with form-perception there is general disagreement as to whether or not form-perception follows a genetic pattern of development. For a time the gestalt psychologist considered that higher mental processes were involved in interpreting the invariance of perceptual forms under transposed conditions. Contemporary gestaltists believe that sensory organization appears as a primary fact arising from elementary dynamics of the nervous system. Piaget takes the opposite position. (See four levels in the development of identity, p. 16) Auditory perceptual structures such as those with which we deal in music are learned. Since learning is involved, it should be possible to apply an operational approach to musical development (15, 6, 8).

5. Inversion. A fifth conservation law applicable to musical concept formation is that of inversion. Inversion when applied to music, refers to the substitution of higher for lower tones and conversely. Two types of inversion can be considered, harmonic and melodic. In harmonic inversion, a note can be shifted to the upper or lower octave. This applies to intervals, chords or entire parts (voices). Melodic inversion, refers to that device by which ascending intervals are changed into their corresponding descending intervals and vice versa, e.g., an ascending major second is changed to a descending major second.

Again reversibility is involved. When an individual realizes that the concept of a triad is invariant whether it is arranged 1 3 5, 5 1 3, or 3 5 1, he is utilizing the principle of conservation. Although melodic inversion does not function in quite the same way, the ability to use intervals in ascending and descending order from a given pitch requires a kind of operational thinking. Melodic inversion plays an important part in fugal writing. In order to understand retrograde inversion and mirror canonic devices used in serial music, reversibility of thought is demanded.

> Mathematics, or better yet, geometry, often implies steps leading to the understanding of a group of signs or a figure according to a different articulation from that which had been stated, to the remaking or transfiguring of the given perceptive constellation. It is in this kind of intelligence that the intelligence necessary for musical comprehension...is found. But what degree of complexity can this figural dialectic reach in compositions in several parts, for example: think of the sum of operational thought implied in the comprehension of the Art of the Fugue. Thus, we can speak of a sort of geometry in time to characterize the forms of thought proper to musical activities.
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> (4 , p. 154)

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Chapter IV

RELATED RESEARCH

Music educators today are concerned with the quality of musical learning that results from the music education curriculum. Seminars have been held and research programs launched to study the curriculum and to make recommendations for curriculum revision. One theme that seems to be dominant in current thought is that the basic underlying structural concepts of music must be taught to children. This is evident in the new elementary music series and methods books which are concerned with the explication of musical concepts.

In "Growth Processes in Music Education," Mursell emphasizes the importance of the formation of musical concepts in a music education curriculum. "Now pattern and organization, in music as everywhere else, depend on concepts, abstractions, generalizations.... Any well-considered scheme of music education is bound to treat the exposition of musical concepts as a central concern (26, p. 152-154).

Leonhard and House believe that perception begets conception for they write that "musical perception results in the formation of musical concepts (23)." They insist that the musical maturation of an individual results from many and varied experiences with music, the outcomes of which should be "the apprehension, naming, and gradual clarification of significant musical concepts (23, p. 125).

It is impossible to find fault with these assertions but they fail to plumb the depths of the problem. Just how do musical concepts develop? What kinds of instruction facilitate their development? The research literature devoted to the problem of the formation of musical concepts is not extensive. Indeed much of the research that has been conducted has been in the dual areas of auditory perception and auditory recall with most studies being focused upon questions of pitch discrimination and rhythmic ability. The purpose of this chapter is to examine selected research studies in the areas of music concept formation, Piagetian theory and perception that provided background for the project.

Music Research That Provided Background for the Study

A fundamental musical concept is that of pitch. In "The Melodic Relativity of Tones," Otto Ortmann (1926) states that pitch is the most characteristic attribute of auditory perception and that the most characteristic attribute of melody, or pitch succession, is motion. "The most fundamental thing we can say about the pitch of two tones is that one is higher or lower than the other.... This fundamentality is at the bottom of the test in pitch discrimination usually given as one test for musical talent.... The most fundamental pitch change in a group of tones is a change in pitch direction from ascent to descent, or the reverse (28, p. 10)."

Myers believes that the aural power of prime importance is the "power to differentiate between pitches of various levels (27)." She holds that the lack of training for individual growth in pitch perception, rather than inability to discriminate pitches is the problem of many non-singers.

Although experts agree that pitch discrimination is fundamental to melodic understanding, attempts to measure children's abilities to differentiate between and among pitches have not been too successful. Williams explains it thusly, "The outcome of the studies now available on the measurement of pitch discrimination before the ninth or tenth year is not particularly encouraging. Several important difficulties appear. The child must have developed to a point where he is able to understand and observe in some fashion the phenomenon of pitch differences and express his discrimination in some simple manner, either verbal or otherwise (37, p. 13)." The criterion to be able to "express his discrimination in some simple manner" is not as easy to meet as might be assumed. A verbal response is perhaps the most efficient; but the terms "up," "down," "higher," and "lower" when pertaining to musical sounds are conventions which must be learned through training, and as such they have no immediate meaning for children.

Another method of response is for the child to reproduce vocally a given musical stimulus. The assumption underlying this type of response is that, if a musical stimulus is accurately reproduced vocally, the concept of pitch has been differentiated from other musical elements. However, it should be pointed out that this ability might show only that the child is a good mimic; it does not necessarily mean that he has an adequate concept of pitch qua pitch. Or conversely, he may be able to discriminate between pitches even though he is unable to reproduce them vocally.

McGinnis (1928) conducted a study to determine the possibility of using Seashore's measures of musical ability with preschool age children. She used three of the six Seashore tests: intensity, pitch and consonance. She found that the tasks were too long and that the children were unable to understand Seashore's terminology of "weak-strong," "high-low," and "better-worse." McGinnis substituted the terms "loud-soft" for "weak-strong," "Baby bear-Daddy bear" for "high-low" and "pretty-ugly" for "better-worse." In using the terms "Baby bear-Daddy bear" in a pitch test with two tones, she asked the children, "Who spoke the last note?" (25) McGinnis' suggestion that in a test of immediate discrimination between the pitch of two tones the child be asked to tell which tone came last, is a good one. In a test of this kind, particularly with young children, the order of judgment must be made very clear. Williams cautions, however, that only where the difference between the two tones is suggestive of an adult's and a child's voice is this method acceptable. In testing finer discriminative ability this comparison would not be applicable.

Williams (1932) tested the possibility of using the terms "high" and "low" or "upstairs" and "downstairs" in pitch discrimination with four- and five-year-olds. Approximately five minutes of training consisted of verbal instruction, demonstration on the piano, singing of high and low tones, and having the children imitate going upstairs and downstairs by steps and by skips. They were then tested on a stepwise progression, an arpeggio, a minor third, and a major and minor second, all played both ascending and descending. His results showed that a longer series of tones covering a wider pitch range is easier than a shorter series, covering a more narrow range. A visual-auditory orientation to high and low by using the piano was quickly established as far as immediate memory was concerned (37, pp. 14-15).

Hitchcock (1942) studied the effect of terminology upon children's descriptions of changes in pitch direction with three- to five-year-olds. Her procedure consisted of a visual picture test and a pitch test using Deagan Bells. She used the polarities high-low, light-dark, little-big, and light-heavy to describe changes in pitch direction. She found that with the younger children, "high-low" was the least useful of the concepts tested for use in pitch discrimination. A shift toward the conventional meaning occurred with increased age. The three-year-olds often used "high-low" with the opposite of their usual pitch meanings. For them the visual meaning of highness and lowness seemed to mean the extent, or length from bottom to top of an object, rather than its specific vertical location. Hence, lowness was analogous to "little" as an airplane high in the sky is little, and highness to "big" as an airplane on the ground is big. Hitchcock found this reversed meaning to exist as long as the child tended to think of objects in relation to himself, i.e., in an egocentric manner. The five-year-olds were able to understand the conventional meaning of high and low pitch. She hypothesized that this was perhaps due in part to a concurrent change in their comprehension of the visual meaning of high and low. In spite of these discrepancies in describing changes in pitch direction, Hitchcock found that it is possible for even young children to recognize a series of pitches and the directional change of pitch (19).

In research designed to study some factors basic to early discrimination learning in children, Jeffery (1958) found that kindergarten children have difficulty responding differentially to the pitch dimension and that the words "high" and "low" mean nothing to them when applied to musical tones. The criterion task was to learn to push one of two buttons, oriented to left and right, differentially to two tones, separated by three octaves and a fifth. Group I had training only on the task; prior to the task Group II had to match the two tones by singing; Group III first matched the tones on marked keys on the piano keyboard. Group II had difficulty matching the tones by singing although they made differential responses. When they were transferred to the button pressing criterion task, they did significantly better than did Group I. This finding would seem to support the writer's assumption that the ability to make an accurate vocal response to a pitch is not a valid determinant of the child's ability to discriminate between pitches. Group III readily learned to match tones on the piano and their transfer to the criterion task was almost perfect. Groups II and III did not differ significantly from each other, but they both differed significantly from Group I. All subjects who met the criterion task were later asked to make the same response to tones differing by 5/8 of an octave. No evidence of transfer to the new tonal stimuli was apparent in any of the groups (22).

One factor that plays a part in pitch discrimination is that of tonal memory. In a study designed to explore, among other relationships, that between tonal memory and pitch discrimination, Bugg and Herpel (1946) concluded that "pitch discrimination is likely to be unsatisfactory when tonal memory is markedly inferior (9)."

Melodic apprehension is dependent upon tonal memory. F. Brehmer (1932) studied melodic apprehension with 76 children between the ages of five years, ten months and thirteen years, five months. His procedure consisted of both vocal reproduction and verbal response. He asked the children to respond "same" or "different" for (1) recognition of changes in familiar motives; (2) recognition of changes in unfamiliar motives; (3) recognition of changes in transposed motives; and (4) recognition of changes in scales. From the results obtained, Brehmer concluded that the ability to think tonally improves with age and intellectual maturity. He found that the tonal thinking of children is dominated by the function of the musical configuration as a whole; young children cannot think in terms of abstractions that deal with various parts of a total melodic shape. Brehmer distinguished three stages in the development of tonal thinking in children: the substance stage, the action stage, and the relation stage. During the substance stage the tones are heard separately as "tone bodies." In the action stage a melody line is followed in its progression, while at the relation stage the relationship of intervals within the tonal context is perceived (6, 7).

These stages in tonal thinking are somewhat similar to Jean Piaget's stages of intellectual development. At the intuitive stage the child reasons from particular to particular. He is unable to coordinate relationships and can deal with only one problem at a time; in his tonal thinking he hears each tone separately and is unable to coordinate tonal relationships. Brehmer's action stage, marked by the beginning of an apprehension of tonality in six- to seven-year-olds, corresponds to Piaget's concrete operational stage. The relation stage of Brehmer presupposes a multidimensional comparison, wherein the child is able to conceptualize intervallic relationships within the tonal context; this stage is analogous to Piaget's formal thought.

A word of qualification for this type of study comes from Ortmann (1926) who found that the psychological status of any tone in any melody is determined by its tonal environment and by its absolute position in the pitch and time series. He further noted that no one tone of any melody can be changed without thereby changing, to a great extent, the status of every other tone in the melody (28, p. 46).

Petzold investigated the "Development of Auditory Perception of Musical Sounds by Children in the First Six Grades." The basic purpose of this study was to examine perception of musical sounds as the aural identification of the similarities and differences between tonal configurations. Petzold found support for the "position that age, as identified by grade level, implies musical growth and maturity that is directly related to competence in the auditory perception of the melodic elements of music (29)."

Children's ability to perceive multiple sounds was investigated by Rupp (1915). He required his two children, ages six and eight, to choose between two renditions of a given melody, one with a major ending, the other with a minor ending. To the children one ending was as good as the other. Another task presented to five children, ages six to eight, required them to choose among three alternate accompaniments for a given melody, two of which were in different keys. The false accompaniments, apart from two bald dissonances, were accepted without hesitation by the children. Rupp concluded that children before age eight are not yet ready to listen both horizontally and vertically at the same time. For them a song is simply a one-part experience. The perception of children of this age range seems to be centered on the dominating factor of melody (32).

Reimers took familiar melodies and distorted certain measures by altering the key. Subjects were given the task of indicating whether or not there was a difference and of locating it. The seven-year-olds had no successes, while only eight per cent of the fourteen-year-olds made errors. Reimers concluded that a true key feeling establishes itself at about age fourteen (31). Here is another example of the perception of younger children being focused or centered upon the melodic line.

Apprehension of rhythm is basically dependent upon the tendency of perception to center upon intelligible and dominating units. An initial apprehension of rhythm depends upon the ability to respond to the rhythmic groupings resulting from the regular recurrence of accented and unaccented beats. In the elementary music program the approach to rhythmic perception begins with rhythmic movement. The majority of research studies designed to study the rhythmic abilities of children have used rhythm in this behavioristic, empirical sense (37, p. 32). This has been studied in two ways. In the first approach free spontaneous expressions of rhythmic activity and actual rhythmic responses to music are observed. In the second approach a regulated, more controlled setting is used which involves the setting up of external patterns of periodic stimulation and measuring the child's ability to recognize the pattern and imitate it under the influence of musical and verbal cues. The criterion of success for this kind of task is the accuracy with which the motor set is maintained for a given period of time. The emphasis is thus on conscious rhythmic perception and inhibitory motor control.

Several examples of this second type of observation can be cited. Vance and Grandprey (1931) tested thirty-one nursery school children at Iowa State College. One task required each subject to play a graduated series of thirteen different rhythmic patterns on a triangle in imitation of the teacher. They found that higher scores were made in reproducing short-long ♪𝅗𝅥 than long-short 𝅗𝅥♩ rhythms (36).

Baldwin and Stecher (1924) required preschool children to clap with wooden clappers in time to a march. Each child's responses were recorded by a kymograph. Their findings, as did those of Vance and Grandprey, indicated that rhythmic ability is not dependent upon age. Two of the best records were made by three-year-olds (2).

Williams found contrasting results when he required preschool children to tap out a regular rhythmic pattern as sounded by a Hollerith counter. He found significant age differences, ranging from seventy-five per cent failure at the three-year-old level to virtually no failures at the six-year-old level (37, p. 62).

Sievers (1932) found that speed or tempo is a factor in rhythmic performance, especially in its effect upon the accuracy of tapping a simple equal periodicity. He also found that rhythmic ability and chronological age may be related when the ability to tap varying complexities of patterns is the criterion (37, pp. 114-172).

Observation of rhythmic responses was the approach used in other experimentation with tempo variation. Hulson (1929) used twenty-one four-year-olds in a group situation in a study to determine whether children's rhythmic performance in skipping, walking or running to music was obtained more easily at any one tempo or series of tempi. The children were directed to move to the music as performed on the piano. The selection was first played at a tempo which seemed appropriate for the specific rhythm pattern at that particular age level. This procedure was repeated but the tempo was varied, both slower and faster. From the variation the observer tried to judge the upper and lower limits of adjustment to tempo for each individual child. If the child's foot movements coincided with the beat of the music for eight consecutive steps, he was considered successful in maintaining the rhythm at a given tempo. Findings were tentative. However, a trend was shown toward one tempo for each of the specific movements as facilitating success with the possibility of increasing the range of adaptation to various tempi with training (20).

In a similar experiment Christianson (1938) found that nursery school children were more successful in synchronizing their movements with fast tempi than with slow ones. Kindergarten and junior-primary children were able to adapt to both types of tempi. A fairly regular progression in duration of rhythmic response at successive age levels was indicated (10). Jersild and Bienstock (1933) also found that children were better able to keep time to fast tempi than to slow tempi (21).

Boekelheide (1960) in a study designed to assess certain basic music listening skills of eight- and nine-year-olds found that eighty-one per cent of her subjects were able to conceptualize running, marching, skipping, swinging, hopping and galloping movements. Most of her subjects had not developed the ability to relate an aural image of a tonal pattern to a visual representation (3).

Pflederer (1963) designed nine musical tasks to explore the area of music conceptualization through an application of Piaget's conservation laws. Her hypothesis was that developmental trends in the conservation of tonal and rhythmic concepts could be discerned through the administration of the tasks to children of two different ages. Results showed a distinct difference between the responses of the five- and eight-year-olds for all but one task (30).

Simon (1965) in a replication of Pflederer's study found a general improvement in performance with increasing age. Simon's study did not, however, support Pflederer's contention that conservation was being studied. Rather Simon believes that it is difficult to assess the individual roles of perception and conception and that it seems impossible to separate the two processes (33).

Replication of Piaget Studies That Provided Background for the Study

Lovell and Ogilvie (1960) replicated Piaget's study of the conservation of substance in the junior school child and found, although their results did not always agree with Piaget, that the three stages in the development of the concept found by Piaget were corroborated, and that the reasons given by children to substantiate their answers were also similar to those found by Piaget (24).

In a series of three replication studies Elkind systematically replicated Piaget's studies in the development of quantitative thinking (1961a); the development of the additive composition of classes in the child (1961a); and the discovery of the conservation of mass, weight and volume (1961b). In all three studies Elkind found results in close agreement with findings in the Piaget studies of three, age-related, hierarchically ordered, stages of development (11, 12, 13).

The usual design in Piaget-type studies is the "classical educational-psychological, transfer-of-training one: (1) to establish a set of subject groups matched on pretest performance vis-a-vis some Piagetian thought form (e.g., all subjects fail to conserve weight); (2) to subject the different groups to different training procedures (with one group assigned as a no-training control); (3) to make a post-test assessment of training effects (e.g., to find out how many subjects in each group now succeed in conserving weight) (14)."

In a well-defined study Wohlwill and Lowe (1962) examined antecedent processes in conservation of number. Seventy-two kindergarten children were divided into four subgroups after having been individually pre-tested on both a verbal and nonverbal Piaget conservation-of-number task. Three groups were subjected to three different training procedures, each of which was highly specif. , and of a narrow compass. The fourth served as a control group. Results showed that the group as a whole showed significant pre- to post-test improvement on the nonverbal measure of conservation. No significant differences were evident in the amount of improvement among the subgroups or between these and the control group. In the verbal measure of conservation, no discernible training effect in any subgroup was evident (38).

Smedslund has reported six experimental studies in the acquisition of conservation of substance and weight. His fifth experiment is particularly interesting. It was designed to test the hypothesis that a state of cognitive conflict is the essential condition for the development of conservation. His training procedure induced cognitive conflict in the subject but did not provide him with feedback as to the correctness of his judgments. Thirteen five and one half-, six and one half-year-olds were subjected to training in which two kinds of transformation of a plasticine ball, deformation and addition-subtraction, were systematically set in conflict with each other. A complete record was kept of the behavior of each subject during the training session. Five of the thirteen subjects consistently followed the addition-subtraction schema and ignored the deformation; the other eight did the converse. Four of the five gave a number of conservation responses in post-test, complete with logical justification; none of the eight showed any improvement. Because shifts from no conservation to conservation accompanied by a coherently stated logical justification have been rare in his research, Smedslund views the four cases as a tentative support for his cognitive-conflict hypothesis (34).

Piaget has found that different attributes of objects are acquired at different ages. Uzgiris (1964) cites a number of studies which have confirmed that conservation of substance is first detectable around the age of seven, that of weight around nine, and conservation of volume around twelve. This sequential development has been established mainly by means of tasks using the same materials to test a given type of conservation. Uzgiris, therefore, conducted an experiment designed to test the influence of the use of different materials on the sequence in which conservation of these attributes first appears (35).

One hundred seventy children in grades one through six served as subjects. Materials used consisted of plasticine balls, metal machine nuts, wire coils and straight pieces of plastic-insulated wire. Conservation of the three attributes was studied using three deformations on each material.

Working independently two observers rated the responses. Ratings were then quantified and arranged in a scalogram analysis. This technique clearly revealed that the attributes of substance, weight and volume are attained in the order described by Piaget. Separate scaling for each material indicated the sequence in which conservation of the three attributes develops is not affected by the various types of materials used in the tasks.

Correlations between scores made on the various materials further illustrate this developmental sequence. Within each grade scores for each material were correlated with the combined scores of the other three materials. High correlations were found at the first grade level where no conservation existed on any attribute, at the third grade level where nine out of ten children conserved substance, and at the sixth grade level where most children conserved both substance and weight. This result was confirmed by an analysis of variance, which also supported other elements of Piaget's findings. Conservation was found to vary with age and with the particular attribute (substance, weight or volume) being judged. Of some relevance to the present study, perhaps, is the finding that for any given attribute, the ages at which conservation was attained varied across materials. Conservation of weight, for example, appeared at a different age for plasticine than when wire was used in the task. Uzgiris attributes this variation to different experience on the part of the subjects with the four types of materials.

Using standardized methods, Goodnow (1962) (18) examined the effects of different immediate environments upon the conservation ability of five hundred European and Chinese schoolboys. Tasks included those involving conservation of space, weight and volume, as well as "factorial-type" tasks testing capacity for systematic combination of several different items. A second combinatorial-type test, Raven's Progressive Matrices, was also included. Subjects were taken from four widely different milieu: European middle class, Chinese from high-ranking Chinese schools, Chinese pupils of low socio-economic status, and Chinese of low socio-economic status with no more than a year of schooling.

Differences between milieu were found to be relatively minor. For the tasks used, boys with one year of school performed no differently than those with six or seven, provided the age was held constant. The order of conservation development of space, weight and volume was found to agree with Piaget's theory, although both weight and volume seemed more difficult to conserve than Piaget implies. Striking similarities across milieu were observed on these variables.

The perceptual-type tasks involving conservation seemed uncorrelated with intelligence. The combinatorial tasks, however, appeared to be affected by wide differences in intelligence. These results are predicated upon the use of Raven's Progressive Matrices as a measure of intelligence, however. As this measure has much in common with the combinatorial or "factorial-type" tasks used by Goodnow, the correlation is not surprising.

The correspondence of age to conservation learning capacity was studied in an ingenious experiment by Frank (1964) (15). Four-, five-, six- and seven-year-olds were first tested for conservation of volume using beakers of different shapes and water. The subjects were then retested with a variation of this classic method in which the final water level was concealed from the child. Beginning with a full and an empty beaker of different shapes, the experimenter poured the water from one beaker to the other in full view of the child. A screen prevented the child from observing the height to which the water rose in the beaker, however. The child was then asked, in effect, if there was now more water in the second beaker than there had been in the first, was there less water, or was there the same. A post-test was then undertaken in which Frank repeated the tests with the screen removed.

When the view of the water level was obscured during the second stage of this experiment, significant increases in correct responses occurred at all age levels. The lack of conservation development in the four-year-olds was graphically illustrated, however, when on the post-test this group reverted back to their original pre-test scores of zero per cent correct. Five-, six, and seven-year-olds, on the other hand, showed striking improvement over their pre-test scores. Frank concludes that learning seemed to have taken place in the case of the five- through seven-year-olds. The four-year-olds, however, remained dominated by what appears to be their one-dimensional perception.

Braine and Shanks (1965a) (4) examined children's conservation of size by determining their ability to distinguish between real and phenomenal size. A series of experiments was undertaken in which illusory size changes were effected by means of the ring-segments illusion, the Muller-Lyer illusion and the use of a magnifying lens.

As in the usual Piaget method, the true difference of equality of the stimuli was made clear to the subject before the apparent change in size was brought about. After the illusion had been created the child was asked, "Which is really bigger?" or "Which looks bigger?" Subjects were reinforced with candy on some of the experiments.

Results were found to conform, in general, to Piaget's stage theory of intellectual development, but the age norms that corresponded to the stages were at variance with those reported by Piaget. The authors conclude that Piaget's norms may be raised by the ambiguity which the wording of his questions presents to the child. "Which is bigger?" may mean either "Which looks bigger?" or "Which is actually bigger?" When this ambiguity is removed, the age norms for the conservation of size drop to about five years. Thus, it would appear that until seven or eight years of age, most children interpret questions about size to mean phenomenal, not actual, size.

What Piaget has been measuring, the authors suggest, has been the ability to make distinctions between real and phenomenal size. Further, this ability does not necessarily include a grasp of the properties of additivity and transitivity. A revision of the theory is therefore proposed: "...additivity and transitivity need to be sharply distinguished from conservation, and the concept of conservation must be broadened to include nonquantifiable attributes...." (4)

As a result of this conclusion, Braine and Shanks (1965b) (5) designed an experiment specifically to test their hypothesis that conservations are direct manifestations of the ability to distinguish between real and phenomenal properties of objects. Subjects were taken from three groups ranging in age from two to five years. The stimuli consisted of different-colored rods, some straight and some bent at a certain angle. After a training session to fix the meaning of the term "bent," the subjects watched the rods as they were immersed in water in such a fashion that refraction caused a reversal of the bent-straight characteristic. The subjects were either asked, "Which *looks* bent?" or "Which is *really*, *really* bent?" (italics theirs). Each trial was reinforced.

The results showed learning to occur in the first three trials when it occurred at all. Age trends in this study were similar to other experiments by these authors in which conservation of a real (as opposed to a phenomenal) attribute was studied. Most of the subjects reached criterion level by about five years of age. This is two or three years younger than Piaget's findings indicate.

The authors suggest that this experiment did not deal with the quantifiable aspect of the attribute which was to be conserved. Whereas Piaget is concerned with attributes such as size, quantity and weight, each of which has the properties of additivity and transitivity, this experiment studied only the discrimination between real and phenomenal properties. The ability to make this distinction, the authors conclude, "is a necessary condition for conservation of all attributes." A modification to Piagetian theory is proposed in which attributes may be classified as simple or complex, depending upon whether or not they are multidimensional and quantifiable, and according to the age level at which their conservation occurs (5).

A group of studies (1) conducted from 1957-1965, including cross-sectional studies and a longitudinal study in which sixty-five children were studied successively in the kindergarten, first, and second grades, considered two major questions: (1) the validity of Piaget's description of the development of understanding of the principle of conservation and (2) the relevance of such understanding to children's progress and achievement in kindergarten, first, and second grade.

> The children's performance in the longitudinal as well as in the cross-sectional study fell into patterns indicating a similar sequence in the attainment of understanding of conservation.... The consistency of findings insofar as the sequence is concerned underscores the importance of maturational factors in the child's ability to conserve and, more generally, in the transition from thought that is intuitive and perceptually dominated to thought that is systematic, or, in Piaget's terms, 'operational.' (1, p. 123)

An interesting series of research studies was carried out over six or seven years under the direction of J. Bruner. These studies were "concerned with how cognitive function changes with age, experience, and exposure to the instruments of a culture (8, p. 67)."

Various findings of the series can be summarized as follows: (1) middle-class children from the Boston area showed 'a pattern of growth in which 'appropriate' rational classification based on the functional properties of things 'replaces' earlier complexive grouping based on the surface properties of events (8, p. 85)." (2) "The psychology of conservation (seems to be) a recognition that the same thing can take many guises and still be the same thing.... It is perception and imagery that most succumb to the error of taking a change in appearance to signal a change in identity (8, p. 224)." (3) Senegalese children do not use "the language of identity or the classification of the present situation according to both appearance and reality to express identity (8, p. 255)."

Embedded Figure Studies That Provided Background for the Study

Professor Joachim Wohlwill from Clark University has suggested that a profitable approach to music concept formation might be found in the embedded figure studies that deal with the development of visual perception.

Ghent (1956) showed ninety-nine children, ages four through thirteen, a series of nine pictures of overlapping line drawings of realistic objects. The subjects had either to verbalize what they saw in the picture or point out the object with a finger. They were then questioned, "Do you see anything else?" The most striking result of this experiment was a consistent decline in the number of omissions with increasing age.

In a second experiment she tested thirty-four children, ages four through eight, who had not participated in the first experiment. These subjects were shown three different series of pictures: A--overlapping, realistic figures; B--overlapping geometric figures; C--embedded geometric figures. The results showed (1) a significantly smaller number of omissions for the geometric figures; (2) better performance with increasing age; (3) a significant decrease in errors on embedded figures with increasing age.

The young children exhibited difficulty in analyzing embedded figures and relatively little difficulty in analyzing overlapping figures, regardless of whether the figures were realistic or geometric. This suggested that "when a figure was so 'hidden' by other forms that the boundaries of the added forms coincided with those of the original figure, the figure would be harder to find than when the boundaries of the added forms intersected with those of the original figure. If there is any validity to such an analysis of the child's difficulty with the embedded figures, then it could be said that the improvement with age reflects an increase in the capacity to perceive a boundary as belonging to more than one figure (16)."

Ghent (1961) in one experiment with seventy-eight children, ages four through eight, and in a second experiment with forty children, ages four through five, attempted to determine whether or not the orientation of pictorial material is determined by the position of the figure with respect to a frame of reference.

Investigation of the response of preschool children to pictures varying in orientation revealed that young children show remarkably consistent preferences for a particular orientation of nonrealistic figures as right side up. Such preferences are surprising, since they are clearly not learned from adults in the culture and they seem to contradict the customary belief that young children are particularly unresponsive to the spatial orientation of visual forms.

Analysis of the stimulus-configurations eliciting preferences indicated that the young child prefers the focal point of the figure to be in the upper portion of the figure or card. Some data suggested, in addition, that the child prefers the main axis of the form to be in the vertical orientation. These preferences have been interpreted as indicating that, in the development of form-perception, scanning of form proceeds in a downward direction.

When the position of the focal part is such as to conflict with this sequential consideration of the form in a downward direction, the child considers the form to be upside down. Judgment of the orientation of a form is usually considered to be based on the relation of the position of a particular figure to the position of other figures in the environment, whereas it is suggested here that, for the young child, the judgment may be based on whether the position of the form facilitates, or conflicts with, movement-tendencies of the child (17).

Wohlwill and Wiener (1963) conducted a study to ascertain discrimination of form orientation in young children. Twenty-four children between the ages of forty-seven and fifty-six months were given a set of matching-from-sample trials which required them to differentiate an outline figure from its up-down or left-right reversal. The children showed a high level of proficiency in this task, indicating a well-developed ability to respond to stimulus orientation as a differentiating cue. Analysis of errors and latency data by type of stimulus figure gave some support to Ghent's downward scanning hypothesis, insofar as up-down reversals gave rise to fewer errors than left-right reversals, and strongly directional figures showed lower latencies than weakly directional ones (39).

Summary The research studies reviewed here show that very little work has been undertaken in the area of musical conceptualization per se. Most of the studies have been concerned with aural discrimination between pitches, between consonance and dissonance, and with the ability of children to respond rhythmically to music. Several of the studies have shown that these abilities increase with age. Few of the researchers attempted to determine the role of various kinds of training, and few attempted to interpret their findings in terms of psychological processes. Yet, musical concept formation has particular relevancy for music education since the quality of an individual's musical learning depends upon his conceptual framework. It is a subject that both needs and deserves further investigation.

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CHAPTER V

OVERVIEW OF RESEARCH METHODS

There are many methods which are unquestionably appropriate for the study of musical learning and musical experience. However, there are very great advantages to the utilization of experimental procedures which permit reasonably careful control over the conditions under which subjects' responses are assessed so that it is possible to attribute the variations in responses to specific aspects of the experimental procedures. Consequently, in most of the studies to be reported we have utilized experimental procedures in which we systematically alter aspects of the stimulus situation and note the variations in the subjects' responses which are associated with the different manipulations which we employ.

The basic procedure in each of the studies has been to take a fairly simple musical stimulus and then to alter it in certain systematic ways and to note then whether the subject can still retain and report accurately on his recognition of elements of the original stimulus. For example, we might take a simple tonal pattern and alter the tempo in which it is played and then note whether a subject who listens to it believes that the tonal pattern is the same one he heard initially. In addition, in four of our five experiments we have altered either the conditions of presentation of the musical stimuli or the experience of the children prior to the presentation of the stimuli in order to be able to determine the effects of these manipulations on the children's responses.

Obviously, some of the very important variables in which we were interested were not susceptible to our own manipulation. Thus, for example, age of children cannot be studied as a manipulated variable. It can only be studied as a subject or organic variable as it is sometimes called. The same is true, of course, for sex of subjects. There are, unfortunately, very serious methodological problems which attenuate the confidence we can have in interpretation of subject variables in experiments. In the case of either age or sex, it is rarely possible to have complete confidence that samples representing these aspects of the subjects are equivalent in terms of other variables which might have a bearing on the experimental performance. There is no way of knowing for sure, for example, that male and female children in the public schools have equivalent musical training, and hence it is very difficult to say anything totally definitive about their performance. Similarly, it is obvious that dropping out of school is progressive over age so that a thirteen-year-old population is more select than a nine-year old population and it is probably different in other ways. Thus, it is difficult to be totally confident that differences between nine-and thirteen-year-olds are attributable to differences in musical ability as opposed to general intelligence consequent to the dropping out of the duller children. Moreover, if there were differences between male and female children, it would be difficult to know exactly to what to attribute them. Whether, for example, such differences are a function of natural biological differences between children or whether they result from differential training on musical tasks of the kind we use, or whether differential motivation is the source of differences. Similarly, it is tempting to interpret differences between children at different age levels as attributable to "changes" or "improvement" in certain kinds of musical or other abilities. However, such conclusions are logically not quite tenable. Testing of the cross-sectional variety, such as we have done, limits one's interpretations of the conclusions. We want to make it clear that we are not claiming that in any case there was actually improvement in performance from nine to thirteen years or between any other two age groups. At this point we can only say that there were or were not differences and speculate about the reasons for these differences. We ourselves believe that children do improve in some of these musical tasks as they grow older, but strictly speaking, our particular experiments do not warrant any such conclusions. Such conclusions would be warranted only if actual longitudinal studies were done showing that individual children did in fact improve as they grew older.

There are also problems occasioned by the fact that certain kinds of experimental groups, for example, classrooms, come to one in discrete units, and we often find it expedient to assign children to experimental conditions in such clusters as classroom units. In such cases, it remains an article of faith that the procedures used do in fact produce comparable samples on the basis of which to compare experimental manipulations. If one teaches one class by one method and another class by another method, it may often be difficult to determine whether any ultimate differences are attributable to differences between the classes which existed prior to the experimental manipulation. The only way to do a true experiment is to take a sample of subjects and assign them randomly to the experimental conditions to be studied. We were not always able to do this, but in general such biases in our experiments have been as minimal as we could expect to achieve. The nature of our tasks and of the training procedures we used precluded pre-testing of the children in order to determine in an absolute way that the children were equivalent prior to the experimental training. We do believe that the methods by which children were chosen and assigned to conditions were sufficient approximations to random assignment that the biases will be minimal. We simply want to note that we are not claiming to have achieved true experiments in the five instances which we report.

In all of our experiments we have used multiple outcome measures for each subject. That is to say, the task produced a number of different measures which could and perhaps should be studied individually. In general, we have placed emphasis upon the total performance of the child across measures, not because we do not think the separate kinds of responses are important, but simply that because of considerations of reliability of measurement we have greater confidence in the total scores across all the measures than in any of the individual scores. Wherever it seemed interesting and appropriate, we have noted differences within or between conditions on the performance of children on different types of tasks.

One aspect of the outcome measures employed which should be noted especially is that in the type of tasks we employed it was possible for a child to achieve a good score simply by saying "yes" to most of the items. The instances in which an original stimulus was presented in a variant form outnumbered those in which a completely different stimulus was used. Therefore, in our experiments we have used procedures to correct at least in part for tendencies of the subject simply to respond with the same response throughout, or we have studied the performance of the subjects on repetitions of the original stimulus as opposed to presentations of completely different stimuli.

One of the problems in experiments of the type to be reported here which involve fairly complex response measurements is the problem of data reduction, that is, reducing the complex responses given by a subject to some simple scoring schema suitable for quantitative analysis. In all of our experiments we have attempted to device scoring systems as simple as possible, feeling that the simplest, most straight-forward analyses should be done prior to more complicated and perhaps more questionable types of data reduction. Thus, for the most part we have examined each individual response by a child to determine whether it conformed to certain very simple criteria of correctness and then have assigned a weight to each response of either 1 or 0, depending on correctness, and have totalled these scores for the subject. However, for Experiment III it was necessary to use a more complex scoring system in which responses were given a weight of +2, if they were exactly correct and +1 if they were only approximations to a correct response. After getting the child's score on each response, we then made the necessary but simplifying assumption that the performance across different types of items was additive so that we could get a total score for a child which represented an overall estimate of his performance on the experimental task. At this preliminary stage of our research we have tried to do the most straightforward and direct analyses, reserving more complex procedures for a later time.

We have used a variety of statistical procedures of varying degrees of sophistication. Our own preference is for the simplest statistic which is at all appropriate. Analysis of variance has been our primary statistical tool because it permits an assessment of the separate effects of our experimental variables and of their interactions. Other procedures have been chosen in order to elaborate findings or to follow up leads not suited for analysis of variance.

CHAPTER VI

EXPERIMENT I: CONSERVATION IN MUSICAL EXPERIENCE[1]

The purpose of the first experiment was to test the relevance of one aspect of Jean Piaget's theory of concept development, namely, that of the principle of conservation to musical growth and development. The problem around which the experiment centered was the identification of conservation in musical development. The experiment was concerned with the rational aspects of musical development. These rational aspects consist of the intellectual controls of operational thought, marked by the emergence and utilization of conservation, pointed to by Piaget in his researches into children's development of concepts of quantity, weight, volume and class inclusion.

The specific objectives of the experiment were as follows:

1. To refine evaluative tools with which to study conservation in perceptual tasks based upon tone and rhythm.
2. To determine whether aural perception and tonal memory can be separated from conservation in tasks based upon aural stimuli.

Procedure

Six musical tasks based on Pflederer's (1,2) research were designed to study the relationship between decentration and conservation as evidenced by the ability to conserve duration, meter, tonal patterns and rhythm patterns. These tasks are as follows: Task I, Conservation of Duration; Task II, Conservation of Meter; Task III, Conservation of Rhythm Pattern under Deformation of Tone; Task IV, Conservation of Melody under Deformation of Tempo; Task V, Conservation of Tonal Pattern under Deformation of Pitch; Task VI, Conservation of Tonal Pattern under Deformation of Rhythm. Each of these tasks required a foil representing the change or deformation made in the shape or presentation of the specific property to test the subject's ability to conserve it. The following table summarizes the musical tasks, the property to be conserved, and the foil.

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[1] A version of this chapter has been published in Psychology in the schools, 1968, 5, 99-105

Table 1

The Musical Tasks

Task	Property Conserved	Foil
Task I	Duration	Durational Values
Task II	Meter	Durational Values
Task III	Rhythm Pattern	Tonal Pattern
Task IV	Melody	Tempo
Task V	Tonal Pattern	Pitch
Task VI	Tonal Pattern	Rhythm Pattern

Each of the musical tasks was presented in a setting representing a classroom situation. (See Appendix B)

Method

The experiment was conducted at one elementary and one Junior High School in Evanston, Illinois, during January - March, 1966. Eighty subjects were distributed over four age levels: ten boys and ten girls each at ages (approximate) five, seven, nine and thirteen years. The grade levels involved were kindergarten, second, fourth and junior high.

A total of four persons was involved in the testing, with the major burden being carried by one graduate and one senior undergraduate and by the first author of this paper. Testing was carried out during both morning and afternoon school periods.

Each subject met with one of the experimenters in two 30 minute sessions. Such time as was necessary was taken to establish rapport with the child, and then testing was begun. Optimum conditions for testing were, however, unfortunately, unattainable. The schools lacked space, and since it was often necessary for two experimenters to be working simultaneously, such diverse areas as a hallway and a wardrobe room were utilized for testing.

During testing each experimenter had available two tape recorders. One was used to present the musical stimuli, and the other was for recording both the experimenter's questions and the child's replies. At a later time all sessions were transcribed in entirety for purposes of analysis. In addition to the tape recorders each experimenter was prepared with a data card on which the child's overall response, i.e., "same" or "different" was to be recorded as a right or wrong response. (See Appendix B) These cards were greatly helpful both for recording purposes and for increasing adherence to the experimental plan. Subsequently, all answers recorded on the cards were checked for accuracy against the tape recorded responses.

The order of presentation of the rhythmic and melodic tasks was counterbalanced in an attempt to reduce practice effects or other unwanted variations by the experimenter. For example, if Subject A did Tasks I, II, and III dealing with rhythm in the first session, then he was followed by Subject B who did Tasks IV, V, and VI dealing with melodic patterns in his first session. Because of the daily schedules of the schools, it was not possible to counterbalance age groups to offset practice effects. Hence, twenty kindergartners were tested over a two week period, then the twenty second graders were tested, and so forth.

Analysis of the Data

The quantitative data resulting from the first experiment consist of the scores of each child on each of the six tasks. On Tasks I, II, and IV the score was simply the number of correct responses, but on Tasks III, V, and VI the score was "corrected" for any failure of a child to identify correctly an exact repetition of the original stimulus, thus correcting in some degree for faulty memory. For example, if a child correctly identified three deformations but also said that a repetition of the original stimulus was "different," his score would be 2 rather than 3, the correction consisting of subtraction of one point for the wrong response.

The plan of the experiment resulted in 10 boy and 10 girl subjects at each of four grade levels, and for each subject there were six measures. Hence, the analysis of choice was an analysis of variance for repeated measures with a 2x4x6 table (3).

Results

The analysis of variance showed, as was anticipated, a highly significant ($F = 74.89$; df = 3,72; $p < .001$) main effect for age and that there was virtually no variance attributable to sex of subject. There was a very large F for tasks simply because the tasks are scored on different metrics and hence the means differ widely.

Table 2

Mean Scores on Six Tasks for Different Age Groups

	Tasks						
Age group	I	II	III	IV	V	VI	All Tasks
5 years	2.20	2.75	5.20	2.90	5.85	6.15	25.05
7 years	1.50	3.75	9.80	3.55	12.40	12.35	43.35
9 years	1.65	4.90	12.75	4.30	14.60	15.10	53.30
13 years	2.25	5.35	15.40	4.70	15.25	15.75	58.70

Table 3

Analysis of Variance for Different Age and Sex Groups for Six Musical Concept Tasks

Source	SS	DF	MS	F	P
Between Ss	2899.54	79			
Age	2190.89	3	730.30	74.89	<.001
Sex	.68	1	.68		
Age x Sex	6.77	3	2.26		
Subjects x within groups	701.20	72	9.74		
Within Ss	11816.33	400			
Tasks	8819.77	5	1763.95	391.12	<.001
Tasks x Age	1342.21	15	89.48	19.84	<.001
Tasks x Sex	7.37	5	1.47		
Tasks x Age x Sex	22.78	15	1.52		
Tasks x Subjects within groups	1624.20	360	4.51		

Of considerable interest is a significant (F = 19.84; df = 15,360; p <.001) interaction between individual tasks and age, suggesting as it does that the different tasks separated the age groups to differing degrees. The task x age group interaction is shown numerically in Table 2 and graphically in Figure 1. Immediately evident is the fact that there are two distinct groups of curves and that the lower group with relatively little slope consists of the three tasks which provided for only four items and therefore a narrow range of scores. Those tasks do not provide for a very sharp separation of the age groups. The three upper curves have a steep slope and separate the age groups very well. It will be noted that Task I, which had to do with the duration of tones, does not produce an age gradient as do the other tasks.

In view of the task x age group interaction and the implication that the tasks have somewhat different characteristics for the various

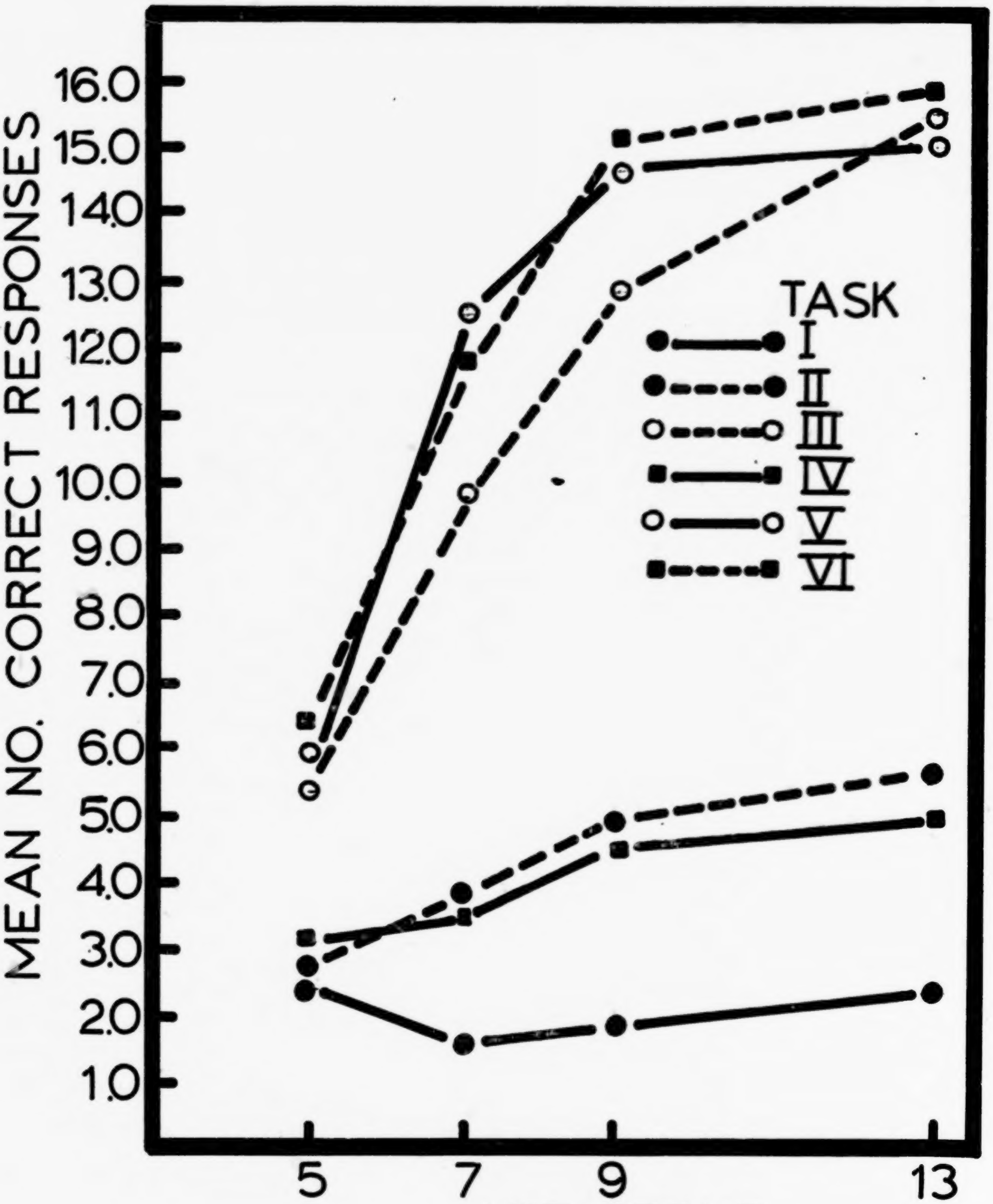


FIG.1 INTERACTION BETWEEN AGE & TASK

age groups, it seemed advisable to determine the reliabilities of the tasks both within and across age groups. The small number of subjects, 20, within each age group means that correlations are likely to be unstable, but some consistency is not precluded. Therefore, split-half reliabilities were calculated for each task at each age level and for each task across all age levels. Reliabilities across age levels should be considerably higher in view of the markedly greater variance of scores.

The reliabilities obtained were interesting in that, as expected, the longer tasks (III, V, & VI) have reasonably good reliabilities, ranging from .74 to .81, while Tasks I, II, and IV have rather low reliabilities, ranging from .02 to .57. Task I may be considered completely unreliable, and its failure to produce an age gradient is accounted for. It was also noted that reliabilities increased with age of subjects, indicating that differences between individual children are more stable among the older groups. Reliabilities for the five-year old children were so low as to call into serious question the applicability of the tasks to that group.

Table 4

Split-half Reliabilities (Spearman-Brown corrected) for
Six Tasks Within and Across Four Age Groups

	Age Group				
Task	Five	Seven	Nine	Thirteen	All Groups
I	.06	.13	.01	.19	.02
II	.27	.25	.37	.39	.49
III	.31	.46	.53	.60	.74
IV	.19	.30	.35	.53	.57
V	.38	.37	.62	.51	.78
VI	.41	.66	.79	.64	.81

It seems also of possible interest to know the correlations between the various tasks, but it is evident that simple correlations across all 80 subjects would be very high because of the marked age gradients. Therefore, correlations were calculated separately within all age groups, and, using an r to z transformation, correlations were averaged across the three older age groups. Because of the very low reliabilities at the five-year level, results for that group were ignored. The resulting average intercorrelation matrix is given in Table 5.

Table 5

Average Intercorrelations of Six Musical Tasks
for Seven, Nine, and Thirteen Year Old Children

Task	II	III	IV	V	VI
I	.10	.15	.04	.29	.13
II		-.02	.04	.23	.06
III			.38	.41	.49
IV				.24	.34
V					.44

It is clear that, as expected, Tasks I and II correlate negligibly with the other tasks. Tasks III, IV, V, and VI correlate positively with each other, and those tasks having similar musical bases do correlate somewhat better, viz., III and VI correlate .49, each having to do with rhythm, and V and VI correlate .44, each having to do with tonal pattern.

Discussion

The findings portrayed in Figure 1 indicate clearly that for all but one of the tasks employed there is progressively better performance as one goes from younger to older age groups. However, for the most part the progression is close to being linear, and there is no evidence for any "stages" in development of the musical concepts tapped here. The two tasks involving conservation of tonal patterns, V and VI, do show some departure from linearity at the upper end of the age distribution, there being very little improvement after age nine. The improvement on those two tasks between five and seven years is also much greater than the improvement on Task III, Conservation of Rhythm Pattern. The asymptotic trend between nine and thirteen years on Tasks V and VI may be partly attributable to the ceiling provided by the limited difficulty of the tasks, but evidently improvement in conservation of tonal pattern precedes improvement in conservation of rhythm pattern.

The results do show that Task I is probably poorly constructed. There is no improvement with age; if anything, the trend is in the opposite direction. One probable defect for Task I is that a good score can be obtained simply by agreeing with the examiner, a response bias not improbable for five-year-old children.

Qualitative Analysis of Responses

All the verbal responses of the children were also categorized into one of seven categories indicative of varying degrees of conservation. However, for the present purposes only two are of special interest: (1) those responses indicative of some degree of but not complete conservation, and (2) those responses indicative of good conservation. Then the total protocols of all children were examined for those which gave evidence of some consistency in conservation across Tasks II-VI. Consistency was taken to be at least two conservation-type responses on any given task and conservation-type responses on at least two of the five tasks. Viewed in such a manner, the data show a clear progression in conservation from the younger to the older age groups. None of the five-year-olds showed consistent conservation, three of the seven-year-olds did so, seven of the nine-year-olds did so, and 14 of the twenty thirteen-year-olds showed consistent conservation.

Undoubtedly verbal facility has something to do with the emission of conservation-type responses, and the infrequency of such responses among the five-year-olds might be a reflection of their verbal handicap. However, arguing against such a simplification is the fact that the five-year-olds were also unable to give correct objective responses to the items. Thus, at least some of their inferiority in the present tasks may be taken as an indication of failure of conservation. On the other hand, it is true that the thirteen-year-olds show somewhat greater superiority in their verbal responses than they show in objective performance, and that greater superiority may be attributable to greater felicity of expression. Nonetheless, the results obtained here argue strongly for the applicability of the concept of conservation in musical learning.

As mentioned above the verbal responses of the children were also categorized into one of seven categories indicative of varying degrees of conservation. These categories are as follows: (1) non-conservation; (2) an intermediate stage; (3) conservation; (4) lack of proper questions by the experimenter; (5) circular responses; (6) incorrect answer and non-conservation response; and (7) conservation-type response but incorrect answer.

The first three categories parallel those found in the Piaget literature. Non-conservation included the correct answer but inability to give an explanation, a subject's sung repetition of the pattern in response to the question "Why?" and a totally irrelevant answer.

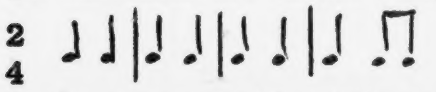
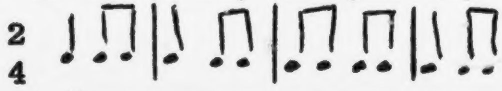
The fourth category was included because the experimenters occasionally failed to follow through with sufficient questions to follow the trend of a subject's thought. Examples of circular responses are as follows: "It's the same because it's the same," or "because it sounds the same"; "It's the same because I think so"; "because"; "It feels like it."

Although Task I proved to be unreliable under the testing conditions of Experiment I, some of the responses do show evidence of stages of conservation. Typical five-year-old responses were "It sounded the same"; and "Because I can hear." This type of explanation is circular and indicative of egocentric thought wherein a child views the world in terms of self. As a group, the seven-year-olds tended to think either that the four shorter tones took more time than the one long tone or that they took less time. They were unable to coordinate the four tones and so to conserve the length of duration.

The nine-year-olds gave responses similar to the seven-year-olds. Three of this age group showed evidence of conservation with responses such as "They added up to the big one"; "They build up to the longer tone"; "You divided them into four parts and they make the same amount when you put them all together." The thirteen-year-olds showed a greater degree of conservation although this was not consistent for the group. Examples of these responses were "I imagined the sound going through the two notes"; "Just the same as the half but it's split into fourths"; "Both were the same lengths combined as the one before."

The following protocol of a thirteen-year-old girl is a fine example of operational thought.

> **"Well, because each of those took, in my counting one and the first one was four." (How can you count the first one if you don't know where it's going to stop?) "I keep counting until it stops." (How do you know how fast to count? You could have counted the first tone faster, couldn't you?) "Yeah, but then I could have counted the short ones that fast too."**

In the discussion of Task II only the first two examples will be considered since they are representative of the Task, Example #1,  , and Example #2,  A five-year-old girl responded to Example #1, "Two, cause every time it was the same thing and like only the last one sounded like three." Contrast the answers of a seven-year-old boy and girl. "Two. The last were faster but still in two." The girl perceived the three impulses in the last measure but was unable to coordinate them, "Three. One was longer and the other two were shorter." The nine-year-olds also showed varying degrees of conservation. "Three because she beat it three times." "Two. Well at first it went two and then at the end it went two-oo, two together." The thirteen-year-olds reflected evidence of operational thinking. "Two. Well it was the equivalent of two beats." "Two. I heard two beats between the accented one."

Example #2 with more subdivisions produced non-conservation answers across all the age levels. Perception centered on the three

impulses in each measure with pre-operational explanations given. Typical responses of the five-year-olds are as follows:

> "That was in threes because it had three sounds on it."
> "I think threes because I heard three noises."
> "Three, cause every time I was really counting in my mind."

All ten 7-year-old boys answered that it was in three; one-half of the 7-year-old girls answered three. Three 9-year-old boys responded three as did four 9-year-old girls. In this example we find a reversal with the thirteen-year-olds. Six of the boys answered three and five of the girls did. However, those who answered correctly showed evidence of conservation explanations. For example: "In twos. The short ones took the same amount of time as the long one." "In groups of two. The middle one is four faster ones."

Explanations for the items of Task III, Conservation of Rhythm Pattern, given by five-year-olds were perception-centered. "It sounded right," or "It didn't sound the same as the teacher's," were typical answers. Some of the responses were in terms of the subject's experience: "Wrong because he didn't listen," or "Right because he was listening." ("He" refers to the child in the story.) The following response of a five-year-old boy to Item 1 of Example #2 indicates that the question "Why?" caused him to doubt his judgment and to change his answer.

> "I think it was right." (Why?) "I didn't say that.
> "I think it was wrong." (Why?) "I think it was right again."

The seven- and nine-year-old responses reflect that the changing tonal patterns interfered with their ability to conserve the rhythm pattern and caused them to give inaccurate answers.

> "She played different notes. Went from a low to a higher to another higher." (age 7)
>
> "Well, it had higher things and it didn't sound the same anyway." (age 7)
>
> "Well, she went up and then she went down." (age 9)
>
> "Wrong, cause his went up and not down." (Was the rhythm pattern the same?) "No." (age 9)

The thirteen-year-olds were able to abstract the rhythm pattern from the pitch as reflected in their explanations. For example,

> "The second one is differently spaced."
> "There was too long before the first and second note."
> "The middle note is held longer."

Task IV, Conservation of Melody, indicated that changing the tempo of a melody interfered with the ability of the five-year-olds to conserve it. Their verbal responses are indicative of this.

> "I heard a different song."
> "Different." (How?) "Very different."
> "She was mixing the notes up."
> "She changed the piano to a different song."
> "They didn't sound the same. They were in longer." (Ex. #4)

The following is an example of the intermediate stage of conservation:

> "The other one plays more music and the other one doesn't play very much. The speed was slower than the first one." (Ex. #1)

It is extremely interesting to note that for the five-year-old who answered, "She changed the piano to a different song," the medium was indeed the message.

We also find it intriguing that a change in tempo was perceived as a change in the quantity of music. Hence, the slower tempo "plays more music and the other one (faster) doesn't play very much." We believe this kind of response to be analogous to the intuitive responses given by five-year-olds as recorded in the Piagetian speed experiments.

Stages of conservation are shown in these representative explanations of the seven-year-olds.

> "The first one was slower and also she had more parts to it. The second one was faster and it wasn't as long." (Was it the same tune?) "No." (Ex. #2)
>
> "The first one was sort of smooth and it was lower and smooth and the second one was higher and...." (Ex. #6)

> "I think that was faster. It was the same tune." (How much faster?) "About ten seconds." (Ex. #2)
>
> "One of them stayed longer than the other but it was the same tune." (Ex. #1)

The responses of the nine- and thirteen-year-olds show a growing ability to conceptualize melody under deformation of tempo. Typical nine-year-old responses are as follows:

> "It was the same song but slower." (Ex. #1)
>
> "Yes, the same melody but slower." (How much slower?) "I don't know. It sounds like quarter notes." (Ex. #4)

Yet a nine-year-old boy answered that Ex. #6 was a different tune because "there wasn't as many notes in the second one; it went faster." The faster tempo caused him to hear fewer notes and a different tune.

The following are representative of thirteen-year-old responses.

> "One of them was sort of close together, you could say. Two of the notes sort of clashed more like one." (Was it the same melody?) "Pretty much; slower though." (How much slower?) "About half." (Ex. #2)
>
> "It was the same except it was faster." (How much faster?) "About twice as fast." (Ex. #2)
>
> "Same melody, but faster." (How much faster?) "Eighth notes, I guess." (Ex. #2)
>
> "Same melody but it went twice as fast as the others." (Ex. #6)

Many of our subjects across the age levels perceived the faster tempi as higher and the slower tempi as lower. The question dealing with comparison of tempo was usually answered in terms of experiential time by the three younger age groups, e.g., ten seconds faster; thirty seconds slower; three seconds faster.

Responses to Tasks V and VI dealing with conservation of tonal pattern parallel those given to Task III. Several of these responses are indicative of categories 5 and 6.

A seven-year-old's response to Task V, Example #1, Item 2 which was transposed a fifth higher than the standard was, "It was kind of wrong. The teacher's went forward and hers went backward." (Category 6)

A nine-year-old boy responded to Task V, Example #1, Item 1 which was transposed a whole-step higher than the stimulus, "Wrong. As he went higher he went in the opposite direction." (Category 6) A conservation answer by a nine-year-old girl to this same item was, "Right. It's up higher but it sounds the same." A thirteen-year-old boy replied, "He just moved it over a key but played the same notes."

The thirteen-year-olds in general tended to explain their answers to Task V in terms of the intervals. For example, "It goes from one note to the step higher and back to the first note."

Two five-year-old responses to Example #3, Item 4 of Task VI are good illustrations of categories 1 and 6.

> "Right because it was faster." (Category 6)
>
> "A different tune because it was faster." (Category 1)

In each instance the eighth note rhythm patterns were perceived as faster than the standard. However, one subject thought that made it right; the other that this contributed to its wrongness. In neither case was the tonal pattern actually conserved as defined in terms of Experiment I.

A nine-year-old answered to the same item: "Wrong. Instead of going on down it went on up here." However, in several instances the nine-year-olds perception focused on the rhythm to the exclusion of the tonal pattern and caused erroneous answers.

> "Sounds wrong cause it's faster." (Example #1, Item 1)
>
> "Wrong. He went too fast at the end." (Example #2, Item 1)

In general the thirteen-year-olds made finer discriminations in detecting invariances.

"He played the same notes but he had a different rhythm." (Example #1, Item 1)

"Wrong, the third note didn't skip." (Example #5, Item 2)

The nine- and thirteen-year-olds showed a much greater tendency to make use of the notational cards as an aid to their judgments. We presume that this was because they were able to link up the auditory patterns with their symbolic, i.e., notational equivalents.

General Discussion

It is premature to be making any firm recommendations concerning training children in music on the basis of the findings reported above. However, we do believe that our findings point toward some practices which should be explored. Primarily, it seems that children might be trained more specifically in the perceptual-conceptual skills that are involved in listening to music and such training should enable them to recognize and to conserve the fundamentals of musical experience. Tonal pattern seems to be such a dominant part of musical experience that special attention needs to be paid to other aspects so that they are conserved despite changes, for example, in melody. One additional point that we would make at this time even though it has not been mentioned previously is that the musical vocabularies of nearly all our subjects were grossly deficient. Even thirteen-year-old subjects had difficulty in explaining the simplest aspects of their musical experience, and they were forced to resort to vague, imprecise, and inaccurate terminology. In many instances it was quite difficult to determine what their experience was because they could not account for it. At a minimum it would appear that school music programs should enable children to talk about their musical experience with the same level of technical vocabulary that is characteristic of other fields.

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CHAPTER VII

EXPERIMENT II: BRIEF FOCUSED INSTRUCTION AND MUSICAL CONCEPTS

A matter of great interest in music education is the ability of children to learn and to employ basic musical concepts. It has previously been suggested that the concept of conservation, as described by Piaget, may well be relevant to musical experience (2). Essentially conservation in music would refer to the ability of an individual to retain the idea of sameness with regard to a complex musical stimulus despite deformations of temporarily irrelevant aspects of the stimulus. For example, a rhythmic pattern might be recognizable in whatever context of tones, tempi, or harmonic variations it occurs. And a tonal pattern might be recognizable even if intervals are distorted or if it is transposed to another key. In previous investigations we have shown some evidence for the relevance of the concept of conservation in musical experience (3).

In previous investigations the occurrence of conservation has been studied as it more or less "naturally" occurs in young listeners. However, it is of great importance for musical education to determine whether conservation can be enhanced by special instruction. This chapter discusses the second experiment of the series which was designed to appraise the effects of a brief instructional period focused on the development of some simple conservation skills in music listening. An additional purpose of Experiment II was to refine the procedures used in previous studies so as to produce a better understanding of conservation and musical concepts in general. The tasks employed in the immediately preceding experiment (4) involved only very brief and "meaningless" tonal and rhythmic patterns, and it seemed highly desirable to develop new materials which would permit the use of complete musical phrases and which would facilitate the study of a wider variety of musical concepts such as harmony, inversion, and interval variations.

Method

Musical Tasks

Four musical tasks were devised These tasks consisted of four phrases selected from Bartòk's piano music For Children (1) in which systematic deformations were made in order to test for the presence of conservation. The deformations which were paired with each original phrase are as follows:

x_i	change of instrument
x_m	change of mode
x_t	change of tempo
x_h	change of harmony
x	no change
x_r	change of rhythm
x_c	change of contour
x_{in}	change of interval

Training Tapes

Experimental: The Experimental Training Tape contained the musical stimuli for one Piagetian task consisting of eight items. A pair of stimuli, consisting of a standard and a deformation, made up each item. The first six bars of "America," played on the piano, was used for the standard of each pair. Following a five second interval the deformation was recorded. The terms applied to each item correspond to the musical characteristic that was changed--or deformed--in order to form the deformation stimulus. All musical factors in the standard except the actual characteristic undergoing the change were held constant in the deformation. A ten second pause separated each of the eight items. Insofar as possible, the order of the items in the Training Tape was dissimilar from any of the orders in which the Test Tape items were arranged. The deformations were discussed during the training sessions.

Control: The Control Training Tape consisted of phrases from the elementary song repertoire. Unlike the Experimental Training Tape no standards of comparison were used. Each of these selections appeared by itself, separated from those on either side by a short section of blank tape. All selections, except the one for oboe, were played on a piano. The instrumentalists were students or faculty at the Northwestern University School of Music. During the training sessions the phrases were discussed in terms of fast, slow, melodic movement, high, low, mode, harmony, and timbre. **(See Appendix C)**

Test Tapes

An entire Test Tape consisted of four tasks. Except for the specific phrases employed, the same procedure used for the Experimental Training Tape was followed in the recording of each of the tasks of the Test Tape master. Separate phrases, taken from Bartòk's For Children, made up the tunes used as standards in the four tasks. Changes were made in the phrases to form the deformation stimuli. Again, only the musical characteristic identifying the deformation was changed between the members of the pair.

So as to cancel the effects of order and practice, a partially counterbalanced design was employed. This involved the use of four different testing tapes, each containing the same stimuli arranged in different orders. The succession in which the four tasks were presented was the same on all four tapes, but the sequence of the eight items within each task was so arranged that each type of deformation was presented equally often in each of the eight positions. Insofar as possible, each type of deformation preceded and followed all other types an equal number of times.

Care was taken that corresponding task items were precisely the same on all Test Tapes. This was achieved by making three copies of the master tape and, by means of cutting and splicing, rearranging the order of the eight items in each of the four tasks. The final result was four separate tapes, each containing the same stimuli, but in different orders. (See Appendix C)

Subjects

Subjects included elementary school children from three elementary schools and two junior high schools.[1] The age groups were five-, seven-, nine-, and thirteen-year-olds. The only criterion for selection was that the children had had no private music instruction. The subjects were randomly assigned to the experimental and control training groups as described above (See Table 6).

[1] The writers wish to express appreciation to the Chicago Public School System and to Illinois School Districts 65 and 68 for their cooperation in this investigation.

Table 6

Number of Subjects in Various Experimental Groups

	Age Five		Age Seven		Age Nine		Age Thirteen	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Control	9	10	17	19	12	13	10	10
Experimental	10	8	16	18	12	14	10	10
Total N	19	18	33	37	24	27	20	20

Three experimenters conducted the training sessions and administered the tasks. To obviate experimental bias the training sessions were counterbalanced. After a training session each subject in that session met individually with an experimenter for thirty minutes for the test. The subjects answered in terms of "same" or "different" and then explained their answers. The "same-different" responses were recorded on coded score cards by the experimenter. Four different sets of score cards had been prepared to correspond to the four test tapes. The test tapes were administered in counterbalanced order.

Each task was preceded by the following directions. The directions were not recorded.

> "You will hear this short tune played several times." (Play the stimulus.)
>
> "Each time that it is played you will hear it followed by a second tune. I would like for you to answer these questions about the two tunes:
>
> a) Is the second tune the same or is it different from the first tune?"
>
> b) Then according to subject's answer,
>
> "What was different about it?"
> "Are they the same in any way?"
> "How do you know?"
> "Tell me more about what you heard."

Two tape recorders were used in the administration of the Tasks, one to play the test tapes and the other to record the subject's responses. The responses were later transcribed from the response tapes.

Because of school schedules and crowded facilities testing conditions were far from ideal. Each age group had to be tested in one block of time; hence, age groups could not be counterbalanced as in an ideal laboratory situation. Nonetheless, results are both gratifying and encouraging.

Derivation of Scores

In order to perform statistical analyses on the data, it was necessary to convert what were essentially qualitative responses into quantitative form, and there were two types of response for which such a transformation was necessary.

The responses of focal interest here were those by which the children indicated whether the musical stimulus they heard was the same or different from the original stimulus, to be called "recognition" here. Actually the children had three alternatives: (1) "same," (2) "different," or (3) "same and different." When the comparison stimulus was a repetition of the original stimulus, the response "same" was correct, but for all other stimuli the correct response was that the deformed stimulus was both the "same and different." Therefore, a scoring system was developed in which a weight of one was assigned to all correct answers and a weight of zero to all incorrect answers. Since each type of stimulus, e.g., rhythm deformation, change of instrument, etc., appeared in each of the four tasks, the range of possible scores for any one type of stimulus was from zero to four. (For statistical reasons all scores were subjected to an arcsin transformation in order to meet assumptions of the analysis of variance.) There were some missing responses either because of a failure of the subject to respond or because of inappropriate questioning by the examiner. However, missing data proved to be very highly correlated across age groups with the occurrence of wrong responses, and on that basis all missing responses were also assigned a score of zero.

The second type of response for which a transformation was necessary was the child's explanation of the relationship between the original and the comparison stimulus. It was hoped that level of conservation could be inferred from such responses. Accordingly a six point scale of level of conservation was developed and applied to the responses. A score of six was assigned to all responses which were clearly indicative of conservation, and a score of one was assigned to responses which suggested that conservation was completely absent, e.g., saying that the tune was different when it had not changed. Intermediate values were assigned to responses indicative of partial conservation. Again, there were a number of instances of missing data, but again it proved to be the case that missing data occurred in almost direct proportion to the number of "one," or absent conservation scores, so missing responses were treated as if they indicated a failure of conservation.

Sixty-four responses for each type of stimulus were scored independently by each of the authors, and product moment correlations were computed in order to establish the ability of judges to apply the scoring system. The correlations indicating judge agreement ranged from .74 for change of interval to .97 for change of instrument. Thus, it appeared that judges working independently would agree very highly. For purposes of the analysis all protocols were scored by the first author.

The range of possible scores for each type of stimulus was from zero to twenty-four since each type of stimulus was repeated four times.

Results

An analysis of variance was performed on the recognition scores with experimental condition and age of subjects represented as main effects and type of stimulus being treated as a repeated measure. The results are presented in Table 7. As expected age produces a highly significant effect, and type of stimulus is also highly significant, indicating that some stimuli are much more likely to be responded to correctly than others. In addition type of stimulus interacts with experimental condition and with age. It will be noted that experimental condition is not significant as a main effect, hence it cannot be claimed that the experimental group is generally superior to the control group.

Table 7

Analysis of Variance of Recognition Scores

Source	df	MS	F
Condition	1	11.81	2.42
Age	3	1082.24	73.93**
C x A	3	23.82	1.62
Ss/groups	191	931.98	
Type of stimulus	7	692.97	119.07**
T x C	7	17.01	2.92**
T x A	21	105.96	6.07**
T x C x A	21	11.29	
T x Ss/groups	1337	1111.64	
Total	1591		

**$p < .01$

Means for the various experimental variables are given in Table 8 in order to facilitate understanding of the significant effects. First, it is immediately evident that the older groups

Table 8

Mean Recognition Scores for Age Groups and
Type of Stimuli Across Experimental Conditions

Stimulus	Age Five	 Seven	 Nine	 Thirteen
ST	2.53	3.23	3.64	3.70
RH	.44	1.05	2.03	2.97
IN	.56	2.48	3.23	3.90
HA	.62	2.25	2.80	3.70
CO_1	.32	1.01	1.73	2.42
CO_2	.35	.83	1.42	2.50
MO	.32	1.24	2.17	3.27
TE	.40	1.63	2.46	3.07

do better than the younger as was anticipated. The age gradient is marked and fairly regular. The various stimuli do not differ greatly in the degree to which they separate the age groups. However, as noted, age and type of stimulus interact, and that interaction must be examined. As shown in Figure 2, the most obvious age difference is that the five-year-olds do relatively well on the repetition of the original stimulus, but they do very poorly on all other stimuli. Such a finding may be explained by the general tendency of the younger subjects simply to agree with everything so that they say "same" no matter what happens. That tendency was noted in our previous study (4).

The one stimulus which is somewhat different in the way in which it separates the age groups is mode, for which there is a regular gradient up to age nine but virtually no improvement after that. Certainly performance is far from perfect at age nine, but the minimal difference from the thirteen-year-old group is suggestive of the need for more systematic training on that variable.

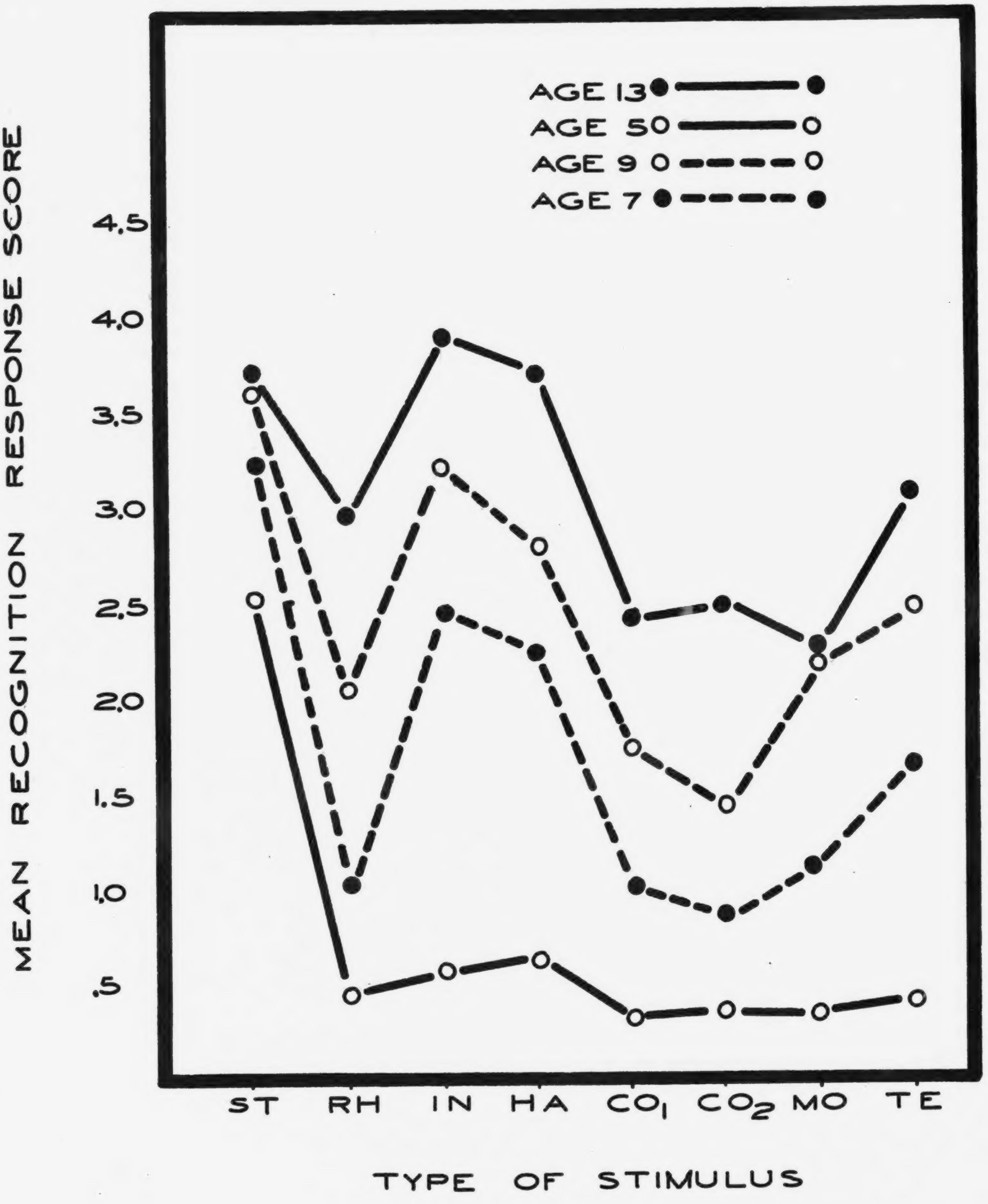

FIG. 2 MEAN RECOGNITION SCORES FOR DIFFERENT AGE GROUPS ON DIFFERENT STIMULI.

Type of stimulus was also highly significant, and examination of means given in Table 8 shows that the repetition of the original stimulus is most likely to elicit a correct response, an obvious but important finding, for it shows that tonal memory is not a critical factor in the poorer responses on other stimuli. Differences between the age groups are considerably larger on all other stimuli than on the exact repetition of the stimulus.

Change of instrument and addition of harmony both produce higher scores at every year level than any other deformation. The results indicate that such stimulus deformations are "easy" in the sense that they permit a child to hear that some change has been made without necessitating the conclusion that the tonal pattern itself has changed. On the other hand, rhythmic and contour changes are almost certain to produce an impression of difference, but they are such radical deformations for our subjects that they do not easily permit conservation of tonal pattern.

Type of stimulus also interacts with experimental condition, and it is here that we get to the critical point of this investigation as an experiment. As can be seen in Figure 3, the experimental group is consistently better than the control group on all stimuli except the repetition of the original. The differences are not large, but they are consistent. Moreover, the difference appears to increase somewhat as we go from the "easy" deformations such as instrument to the more difficult ones such as mode and contour. These findings will be discussed below.

A second analysis of variance, reported in Table 9, was performed on conservation scores, and it conformed in all respects

Table 9

Analysis of Variance of Conservation Scores

Source	df	MS	F
Condition (C)	1	9.62	1
Age (A)	3	3031.45	69.14**
C x A	3	24.94	1
Ss/groups	191	43.85	
Type of Stimulus (T)	7	3260.68	377.54**
T x C	7	9.14	1.06
T x A	21	115.55	13.38**
T x C x A	21	.76	1
T x Ss/groups	1337	8.64	
Total	1591		

**$p < .01$

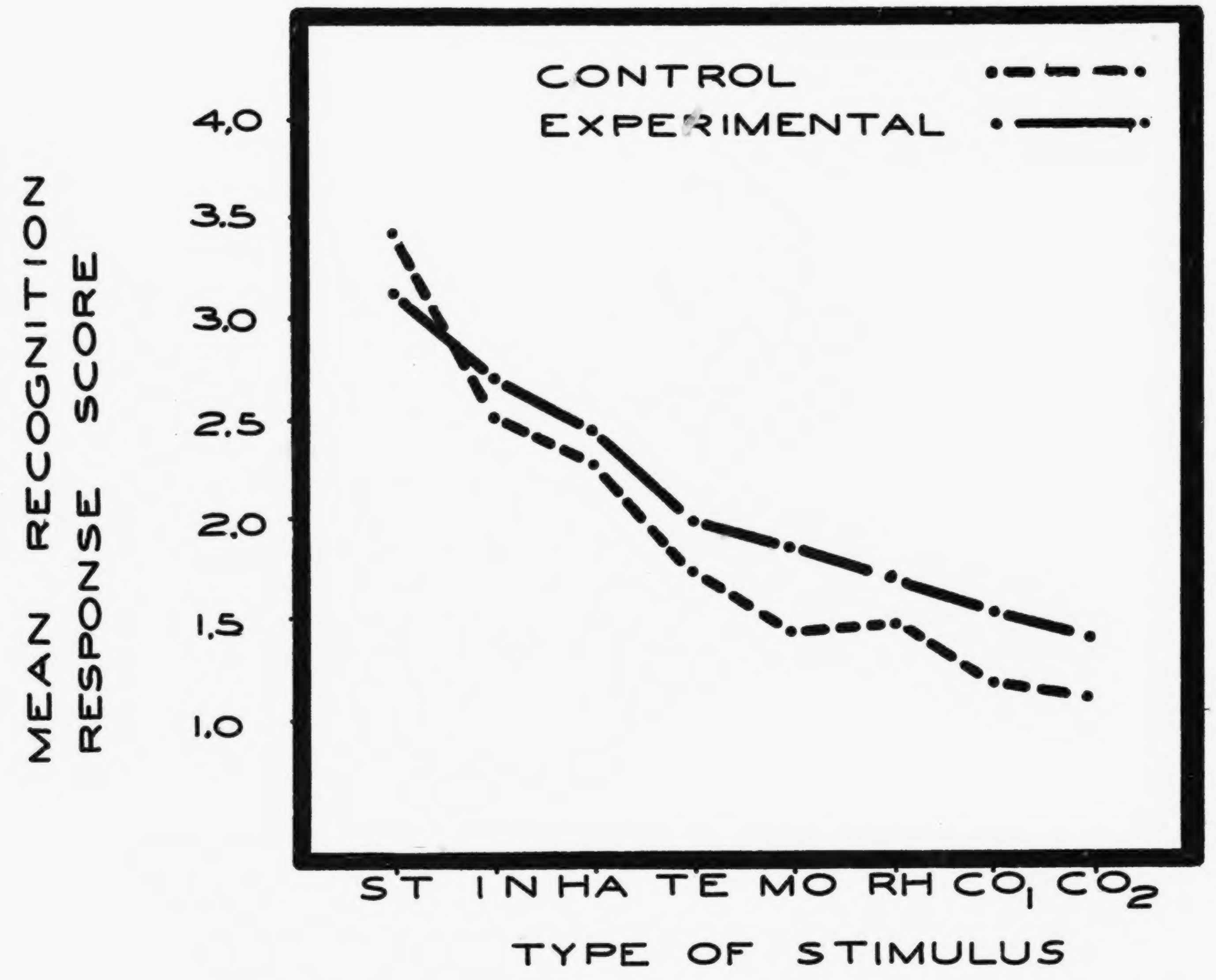

FIG. 3 RECOGNITION SCORES OF CONTROL AND EXPERIMENTAL GROUPS FOR THE DIFFERENT KINDS OF STIMULI.

to the first analysis. Age and type of stimulus again produced highly significant effects, and there was a highly significant interaction between type of stimulus and age. The relevant means are presented in Table 10.

Table 10

Mean Conservation Scores for Age Groups and Type of Stimulus Across Experimental Conditions

	Age			
Stimulus	Five	Seven	Nine	Thirteen
ST	16.91	20.01	21.47	22.50
RH	8.21	9.54	10.56	13.90
IN	10.35	17.29	19.96	23.40
HA	9.32	8.21	15.40	20.37
CO_1	8.13	9.37	10.11	10.70
CO_2	8.05	8.80	9.42	11.17
MO	8.32	10.38	12.86	15.60
TE	9.14	14.12	16.58	19.92

Again we can see that there is a marked and fairly regular age gradient. The older children do much better than the younger ones. The results for type of stimulus are highly interesting. As would probably be expected, repetition of the original stimulus tends to produce good conservation responses and, in general, instrument, harmony, and tempo produce high conservation scores. However, while not shown in Table 10, when good conservation responses (i.e., those scored six) were examined, it is interesting that harmony, tempo, and the two contour deformations produced more conservation-type responses than did instrument, rhythm, and mode.

Finally, it is interesting to look at the interaction between type of stimulus and age as given in Figure 4. Once again the exact repetition of the stimulus produced relatively small differences, with even five-year-olds being able to give some conservation-type responses. On the other hand, there were very few and very poor conservation responses within any groups for the two contour changes. Both instrument and harmony, along with tempo, produced a number of

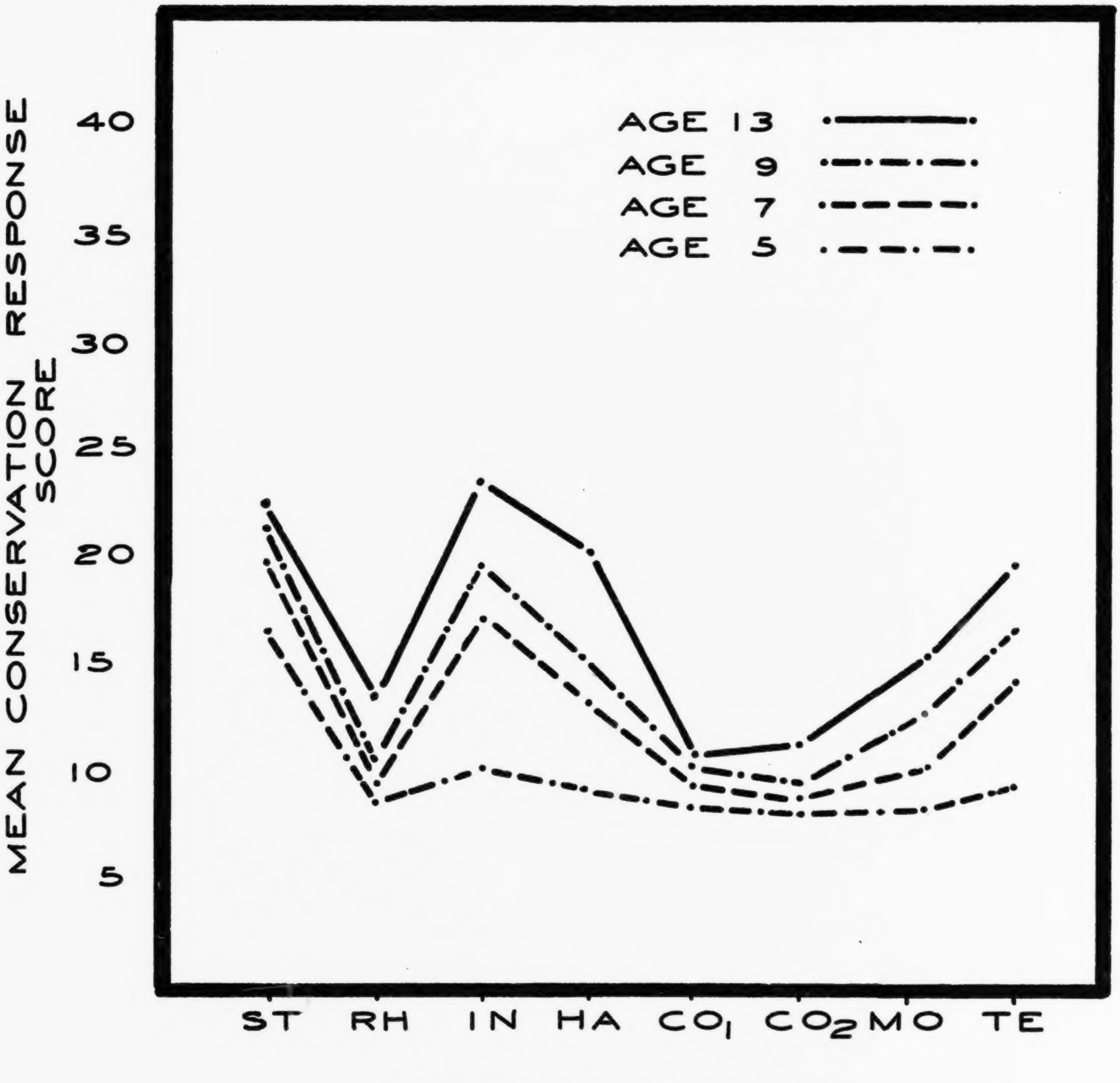

FIG. 4 MEAN CONSERVATION SCORES FOR DIFFERENT AGE GROUPS ON DIFFERENT STIMULI.

conservation responses among the older groups. For the five-year-olds virtually the only responses scorable were for repetitions of the original stimulus, but for the thirteen-year-olds instrument, harmony, and tempo produced as many or more conservation responses as the repetition of the stimulus.

Discussion

It is perhaps unfortunate that the experimental effect of instruction demonstrated here was so small, but in other ways it may be regarded as remarkable that any effect at all was obtained. As was indicated earlier testing conditions were far from ideal, but more important is the fact that the actual amount of instruction given on these complex musical concepts amounted but to a few minutes. We are confident that longer, more intensive instruction would have produced much more striking effects. Although the results are not statistically significant it is fortunate that the small effect obtained seems generally to be greater for the most difficult and complex deformations.

It will have been noted that no effect of the experimental instruction was obtained for the conservation scores, but it should be noted also that the instruction was focused almost entirely on the recognition response, and there was no reason to expect any special improvement in the ability of the children to express in verbal terms their musical experiences. The number of conservation responses and the quality of those responses in relation to different stimuli varies rather markedly and, we suspect, with the properties of the particular stimuli. Some stimuli seem more readily than others to produce verbal responses which are classifiable as "conservation" responses. The deformations themselves may be graded for "difficulty" both with respect to the degree to which they permit recognition of change and sameness and the degree to which they produce conservation-type responses. However, the fact that conservation occurs easily for some kinds of stimuli suggests that it should occur for all stimuli used here. In theory there is no reason why the addition of harmony should prove less disrupting than the alteration of a rhythm pattern. The reason that it is less disrupting probably relates to the amount of prior experience and perhaps to the nature of that experience.

There is a very strong "age effect" in this experiment as in previous ones, with the older children being superior on every facet of the task. Apparently the superiority of the older children is not entirely attributable to better tonal memory or other response capability. Almost certainly a better musical understanding is involved. Nonetheless, it is important that some type of musical task be devised in which the critical response is not dependent upon verbal capabilities, and the writers are currently testing such a task. It is obvious that children at every age level could use a good bit more instruction on nearly all the kinds of stimuli studied here.

Qualitative Analysis of Responses (5)

A. Conservation-type Responses to Musical Stimuli

Essentially conservation in musical earning refers to the ability of an individual to retain the invariant quality, i.e., the sameness of a complex musical stimulus in spite of variations in its presentation. This discussion will examine types of responses denoting non-conservation and conservation for each of the age groups and each of the deformations. An intermediate stage of conservation was identified when the deformation was recognized but with uncertainty as to the "sameness" of the two phrases. Indications of true reversible thought were found as early as age seven. These are marked by use of the "if......then" proposition and clauses beginning with the preposition "except."

Instrument

The instrument deformation brought one of two responses, either the tune was conserved as being the same or the timbre of the instrument interfered with conservation. In these instances perception tended to center on the unique quality of the instrument and the entire tune was perceived as different. The following protocols exemplify these types of responses.

Five-Year-Olds

Non-Conservation:	Different, cause one was on a piano and one was on a horn. (Were they the same in any way?) No.

Conservation: The second one was different. It was done by a clarinet. (Were they the same in any way?) Just the same song, but it was done in a different way by a clarinet.

Seven-Year-Olds

Non-Conservation: The second one was a trumpet, the first one was a piano. (Were they the same in any way?) No. (Were the two melodies the same melody?) No.

Conservation: That's played with the violin instead of the piano. (Were they the same in any way?) The song was the same, except they played it with a different instrument.

Nine-Year-Olds

Non-Conservation: Well, they were played on different instruments. That's what they sound like. (Do you know what the instrument is?) No. (Were the songs the same in any way?) No.

Intermediate: One was played with a different instrument and one was played on the piano. (Were the songs the same in any way?) I don't know.

Conservation: It was the same melody, but it was played on a different instrument, a trumpet or something.

Thirteen-Year-Olds

Non-Conservation: Different instrument and it was played a little slower. (Were the tunes the same in any way?) I don't think so. I don't think they were playing the same song in that one.

Intermediate: Different. Different instrument. (Were they the same in any way?) Yes, same rhythm. (Any other way?) No.

Conservation: They were exactly the same but the second time it was played with a different instrument and because of the instrument's range, the notes were higher. (Do you know what instrument it was?) The violin.

Tempo

A wide range of non-conservation to conservation across the age groups can be seen in responses to tempo. Non-conservation took one of two forms: perception centered on the deformation and the tune was not recognized; perception centered on the tune and the change went unnoted.

Responses analogous to examples of pre-operational thought recorded in the Piagetian speed experiments were found as late as age thirteen in our experiment. In these responses a change in tempo was perceived as a change in the quantity of the music. Thus a faster tempo has less notes while a slower tempo plays more notes. Excellent examples of reversible thought made quantitative comparisons of tempi, e.g., half as fast or twice as long.

Five-Year-Olds

Non-Conservation: One was played short and one was long. (Were they the same or different?) Different. (Were they the same in any way?) No.

They are both exactly the same.

Conservation: The second one seems a little bit slower. It is different because one is slower. (Were they the same in any way?) Yes, because they sounded in the same tune.

Seven-Year-Olds

Non-Conservation:	That whole thing was wrong, and it was short. (Were they the same or different?) Different. And it was shorter, because the tunes were wrong. (Did they sound the same at all?) The....second one didn't 'cause the second one was shorter. They weren't the same. (What was different?) Well, the first one it was sort of like the same only it played more of those notes. (What happened in the second one then?) Well, it sort of, it went the same notes about two times and then it would go on. (Tell me more about that.) I can't.
Conservation:	It was the same, but it took longer to do the whole song. (How much longer?) About 5 seconds longer. It went faster. (Were the songs the same in any way?) If it hadn't been so much faster, then they would have been the same.

Nine-Year-Olds

Non-Conservation:	Different, it was played faster. (Were they the same in any way?) I don't think so.
Conservation:	They were different. One was a lot faster. (Were the songs the same in any way?) If one was a lot slower, they would be the same. They were the same melody, but it was played slower. (How much slower?) About half as slow. (How were they the same?) It sounded like they played the same notes, but they just played them real slow, instead of at the other speed.

Thirteen-Year-Olds

Non-Conservation: It was the same. (Anything different?) No.

That wasn't played the same way. It was a different tune altogether. (Were they the same in any way?) No. (What was different?) Like it was a different tune and a different beat.

Intermediate: There were more....there were less notes; it was faster. The rests were in different places. It wasn't the same tune; the notes were about the same. (How much faster do you think it was?) Not quite twice as fast. (You said that the tune was different and the notes were the same.) They were about the same. (What do you mean when you say the tune is different?) Well, it, it goes at a different rate. You can't tell that it's the same thing. (But the notes are about the same?) Yeah. Some of them might have been....I don't think....I don't know.

Conservation: Same notes, except it played half as slow.

Well, I'd say the second one was played at about half, half the tempo as the first one. Half as fast....it was twice as long. (Were they the same in any way?) Yeah, same tune.

Harmony

The addition of harmony caused many subjects to hear more than one piano and even other instruments. In this deformation when perception centered on the harmony the tune was perceived as different.

Five-Year-Olds

Non-Conservation: Different, because one is playing with a whole bunch of keys and the other is only playing with two. (Were they the same in any way?) No.

Conservation:	The second one was chords. The first one didn't have chords. (Were they the same in any way?) Well, the song was the same and the piano was the same.

Seven-Year-Olds

Non-Conservation:	Different. They were using more fingers than the first one. (Were the songs the same in any way?) No.
Intermediate:	That's different because they played the piano. They played the piano with the other instruments. (Were they the same in any way?) Yes, the song was, but, um, some of the music in the middle wasn't because, um, the piano was playing.
Conservation:	If they took off the four, and then it would be the same. They had a low note after each note. They could be the same at the end if they took away the low notes. Well, it's just a little different. They had another new note after the other one. (Was there anything the same about them?) Not exactly. Just the notes if they didn't put the new....it would be the same if they didn't put the chord in it. Yeah, I think it would be the same.

Nine-Year-Olds

Non-Conservation:	In the middle of the second song they started to play two hands together. (Were the songs the same in any way?) No.
Intermediate:	The second one was played with two hands and the first one with one hand. (Were they the same in any way?) I don't know.

Conservation: They were the same song, but two people were playing it. (What is that called?) A duet.

They were the same. It was played with chords, but it was the same in the melody.

Thirteen-Year-Olds

Non-Conservation: Well, that's still played by the piano and they added some chords to it. I'd say it's a little bit higher than the first one. (Are the tunes the same in any way?) No.

Intermediate: It's different because on every third note they played a chord or an interval. They played more than one note. (Were the tunes the same in any way?) The first notes were the same. It was different because it didn't play the same amount of notes. (What do you mean by that?) It played three notes and then it moved, the last one had more of a chord.

Conservation: Most of it was harmonized; otherwise it was the same. (What was the same?) Well, the second one was the same as the first with harmony put in.

They add chords to that one. Otherwise it would be the same.

Mode

Non-Conservation responses to mode revealed that either the deformation was not perceived or that it was the centering perceptual focus. In several instances the wrong reason was given to describe how the tune was different.

Five-Year-Olds

Non-Conservation: I think they're the same. (Anything different?) No.

Thirteen-Year-Olds

Non-Conservation: That was different, like about the third key to the last note it went low. It made it different. It changed the whole melody of the song. (Were they the same in any way?) No.

It was different because in the middle it kind of went sour. Went higher. Didn't play the same as the first one. (Were they the same in any way?) No.

Conservation: It was the more solemn kind of song.... tune. The notes were lower, and it was kinda, I guess, minor. (Were the tunes the same in any way?) The tune was about the same.

Rhythm

Responses to the rhythmic deformation indicated that an inadequate and often inaccurate vocabulary made the deformation difficult to describe. In many instances subjects would try to sing one of the stimulus patterns in order to communicate their ideas about it.

Five-Year-Olds

Non-Conservation: Different. I think it was a little bit too bumpy, bump, bump, bump. (Were the tunes the same in any way?) No.

Conservation: No. (What do you mean 'no'? Are the two tunes the same or different?) Different. (How are they different?) It was the same, but....it was the same but it had two....you know, it was two going like that, ♩ = ♫. (In which one, the first tune or the second tune?) The second tune.

It didn't sound like the same....cause the instruments didn't sound the same. (Were they the same in any way?) No.

Conservation: Different. It was creepy. (Are they the same in any way?) The song was the same and the piano was the same.

Seven-Year-Olds

Non-Conservation: They were different. (What was different about them?) The tune. (Can you tell me how the tune was different?) No. (Were they the same in any way?) No.

They were the same. (Were they different in any way?) No.

Intermediate: Well, second one was kinda low. Or was it the same? Yeah, I think it was the same. But no, second one was lower on the first couple notes. (Were they the same in any way?) Yeah, but the second was a little bit lower. (How were they the same?) The same notes but the other one was kinda high and the second one was low. (Were they the same in any way?) I don't think so. Yeah, I think they were the same.

Conservation: It got lower at the end. (Were they the same or different?) If it hadn't dropped at the end, then the tunes would have been the same.

Nine-Year-Olds

Non-Conservation: One sounded like it was going down the key farther. It didn't sound like it stayed up on the higher ones. It just kept going down. (Were they the same in any way?) No.

Conservation: They were the same. They sounded a little bit like somebody made a mistake in it, in the middle. They were the same song.

That was in a minor key; it was the same tune.

Seven-Year-Olds

Non-Conservation: Different, because some of it was played a little with two, two of the same notes type. (Were the tunes the same in any way?) No.

Conservation: The second one had a....was played again.... like "da-da" like that. It was different; it was played two times....same notes two times; sometimes it wasn't. (Were the tunes the same in any way?) Except for those two, uh, extra keys.

Nine-Year-Olds

Non-Conservation: That was a different tune entirely. (Were the tunes the same in any way?) No.

Conservation: They were different. (What was different about them?) One of them was putting an extra note in after. (Were they the same in any way?) If you took the extra note off, they would be.

Well, it's the same, but the long ones are shorter and the short ones are longer. And they are sort of bunched together. (What do you mean?) Well, they're the same notes, but they are grouped differently. Like (child sings two identical three-note patterns, changing the rhythm in the second) and the short ones are longer and the long ones are shorter.

Thirteen-Year-Olds

Non-Conservation: That was different because it stayed on two keys twice. It gave it one tap and then gave it another tap. (Were the tunes the same in any way?) No.

Conservation: They were the same notes but they were played in a different time and in different places.

The second time they were the exact same keys but they were grouped differently and they were played... some were grouped together in two, and some together in three.

It's different. It's um, the notes are closer together in some places, and then they're further apart. (Were the tunes the same in any way?) The notes seemed to be the same, except that the rhythm is different. (What do you mean by 'notes'?) Um, the.....you know, um, pitch. Well, like A and B and the rest.

Contour and Interval

Change of contour (Contour I) represented an inversion of the stimulus and change of interval (Contour II) varied the size of the interval within the same directional movement. Responses to these two deformations did not provide fine examples of non-conservation and conservation since the nature of the deformation did change the quality of the stimulus. The following responses are representative of those given to these deformations.

Contour I

Five-Year-Olds

Non-Conservation: The same. (Were the tunes different in any way?) No.

Intermediate: Different. It was played differently. It got played with some notes that went to other songs, in the middle. There's a B and some other notes. (Were the tunes the same in any way?) It was played by a piano and so was the first one.

Seven-Year-Olds

Non-Conservation: The same. It could be a little different on the second one because it was low. The second one was going down.

Conservation: ....I think it went backwards.

There were a couple of low ones, and it wasn't the same as the first one. If it had....if it didn't have the low ones it would be the same as the first one.

Nine-Year-Olds

Non-Conservation: The first one (played) different sides of the piano. (What do you mean?) There is two sides and they go over there and then over there. (Were the tunes the same in any way?) No.

Conservation: All the high notes were lower. It was the same in some of them, but it seemed that most of the high notes were lower. It was played in a lower key. Some of the notes were the same.

Thirteen-Year-Olds

Non-Conservation: It's about the same in the beginning but it goes down and then up again. They were different.

Conservation: It was sort of turned upside down and inside out. Similar melody, just upside down.

It reversed; it went down instead of up. Well, instead of going like it did, the second little group of three notes went down and so did the third. (Were they the same in any way?) Well, the tune's the same. (How were they different?) The, uh, the notes, the three notes, the groups of three notes went down instead of up.

Interval (Contour II)

Five-Year-Olds

Non-Conservation: Different. (How?) They were playing on different keys ....on different keys, all different. (Were the tunes the same in any way?) No.

Intermediate: Different. It was played in a different way. It was played by a piano and it was played in some different tunes. (Were the tunes the same in any way?) The song was all the same. There was a different tune from the starting and the ending because first there was the first real song and then different. Started with the same kind of notes.

Conservation: Different. (Were the tunes the same in any way?) The song. (What do you mean?) Well, I mean not the way they put the song, but it was the same song.

Seven-Year-Olds

Non-Conservation: It went low, then it went high, then low, then high. (Were the tunes the same or different?) Different. (Were the two tunes the same in any way?) No.

Conservation: One was high, and one was low. (What do you mean?) Almost like he had the l.... it was a low one....and, he had almost, just about three notes it was higher. (Were the tunes the same in any way?) Yeah. (In what way?) Well, se....'cause if it wasn't the high and the low one, it would be the same.

Nine-Year-Olds

Non-Conservation: It was an entirely different tune. (How was it different?) I don't know. Oh, the tune was different. (Were the tunes the same in any way?) No.

Conservation: Well, most of them were the same, but the low ones were high and the high ones were low. It was a lot the same. It was based on the same notes, but they were different in some of the notes.

Thirteen-Year-Olds

Non-Conservation: That was played the same. (Was there anything different about it?) I don't think so.

Conservation: Sort of went up. It just kept on going up instead of down. And in some parts much higher than it was. (Were they the same in any way?) Yes, the beginning and the end. It was just the inner part that seemed to be the opposite.

Same basic melody, but sort of like a different melody. Some notes go up and some go down; just the opposite of the way they were going before.

Stimulus

A paired repetition of the stimulus was included to test for tonal memory. The following protocols are cited here because of the insight they provide into children's thinking about musical identity, i.e., repetition.

Five-Year-Olds

They were all the same. No differences.

They were both the same. They had the same song to it.

The same. (Anything different?) Yes, it was alike, but....no, there wasn't anything alike. It was....no....nothing was different. (Were the tunes the same or different then?) The same.

Seven-Year-Olds

It was exactly the same.

Went the same, the same amount and the same tune and fast.

Nine-Year-Olds

They were exactly the same.

Sounded like they were meant to sound the same.

Those were the exact same. Equal, like in math.

Same song, same key, same notes.... nothing different.

Thirteen-Year-Olds

Same exact thing.

That was the regular song.

That was the same; the same melody being played twice.

The same exactly.

It was the same melody and the same beat. (Different in any way?) No.

We believe that these responses give a good picture of the way in which children think about the music they hear. In addition the responses show that a kind of conservation does operate in musical learning and comprehension, even among the five-year-olds. We believe that experiences designed to take advantage of conservation principles should be planned for the listening, performing, and creating facets of the music education program.

B. Verbal Responses to Musical Stimuli

A particularly fascinating aspect of the responses of children to the musical stimuli of Experiment II is the variety of terms in which they construe this experience. Hopefully, of course, children will learn eventually to use most of the same technical terms as are used by musicians, but they often also seem to have responses which involve some form of imagery. While there have been various reports of the musical imagery of both children and adults, few such reports have utilized systematically varied but standardized stimuli.

In the experiment just reported musical stimuli were presented to children, and they were asked to respond by indicating their awareness of similarities between a comparison and an original stimulus. They were also asked to explain their answers. These explanations constitute the material for this discussion.

Categorizing the Responses

After considerable study of the protocols, five primary categories of verbal description were developed. These were: (A) Method and/or medium of performance; (B) Simple description (often, but not always, accurate) of the musical stimulus; (C) Affective reaction; (D) Imagery, including responses suggestive of synesthesia; (E) Reference to rhythmic movement.

An initial independent categorizing of the responses by the two authors produced very good agreement which became substantially complete after categories B and C were separated and E was developed as an additional category. The table which follows provides examples of the five categories.

Table 11

Examples of Responses in Each of the Five Categories

Category	Stimulus	Response	Age
A	Contour	Played on the left side of the piano.	9
		Like playing a descant part.	13
A	Interval	Both played the same song, but it came out a different tune.	9
A	Harmony	A lower piano cut in the second one.	9
		Pianos playing twice.	13
		Pressed down too hard.	7
A	Instrument	You were playing a different....a toot.	5
		The first one acts like a piano and the second one acts like a horn.	7
A	Mode	They pushed half down of the other one; it was the same except for that.	7
		One kept going down the key farther.	9

Table 11. (Continued)

Category	Musical Stimulus	Response	Age
A	Rhythm	There were two keys playing at the wrong time. Played two at a time and then paused.	7 9
A	Tempo	Some was played twice of the same note. It was like pushing the finger up and down real hard.	7 9
B	Contour	It's the same height of music but it went a different way. Musician took his music and turned it upside down on the piano.	7 13
B	Interval	Sounds like it's going from side to side. Well, it did go up kind of, and then it leveled off.	9 13
B	Harmony	That music which had two things together. It was a little fancier because it was two-handed in the middle.	5 9
B	Instrument	The same playing. Same height.	7 13
B	Mode	Dropped at the end. In some parts it was flat instead of regular	9 13
B	Rhythm	The second one had different beats here and there. That one had two doubles in it.	5 9
B	Tempo	It was longer; the tune was longer. Two seconds slower.	7 9
C	Contour	Second one sounded a little wicked.	7

Table 11. (Continued)

Category	Stimulus	Response	Age
C	Interval	Sounded a little bit happier.	9
		One sounded squeaky.	7
C	Harmony	It's a little more prettier.... it sounds more like music.	7
		The first one was dull and the second was high.	9
C	Instrument	None	
C	Mode	Second one sounded real sad.	7
		First gay; second something bad happens.	9
C	Rhythm	Second was a little goofy.	5
C	Tempo	Second one was ugly.	5
D	Contour	They made it with fake notes.	7
		One was wrinkled, like low.	7
D	Interval	Smooth like down.	7
		Sort of hazy.	9
D	Harmony	Sounded like church music.	5
		They had company.	13
D	Instrument	It was as though it was hitting in the can.	5
		Sounded like bones.	5
D	Mode	Second one got tired.	7
		Up and a little shorter, skinny.	9
		Half a per cent lower.	9
		The sound is getting sorta warped.	13
D	Rhythm	Condensed into one little thing, like a color movie.	13
D	Tempo	Sounded a little about my church song.	5
		Sounded like a funeral was on.	9
		Just like it was lying there.	13

Table 11. (Continued)

Category	Musical Stimulus	Response	Age
E	Contour	None	
E	Interval	Second one marched up and down a little.	7
E	Harmony	That one had a bounce to it.	9
E	Instrument	None	
E	Mode	It dragged. Notes were running together or something.	9 13
E	Rhythm	Some skipped; other ones hopped A triple jump, like a horse trotting.	5 9
E	Tempo	Second one was wiggly. Galloping tune. Walking notes and running notes.	5 7 9

Results

The frequency of usable verbal descriptions for the various kinds of musical stimuli were as indicated in Table 12.

Table 12

Frequency of Usable Verbal Descriptions

Musical Stimulus	Categories					Total
	A	B	C	D	E	
Contour	6	7	1	6	0	20
Interval	4	12	3	3	3	25
Harmony	87	37	6	6	2	138
Instrument	10	5	0	7	0	22
Mode	15	13	20	13	5	66
Rhythm	11	36	1	3	25	76
Tempo	18	55	1	5	10	89
Total	151	165	32	43	45	436

The most frequent type of verbal response fell into Category B which is concerned with simple description, but Category A, concerned with some element of performance, was a close second. Rhythmic movement, imagery, and affective responses were all of lower but important frequency. Viewed the other way, the harmonic variation produced the largest number of responses, with tempo, rhythm, and mode still producing important numbers of responses.

Category A, Method and/or Medium of Performance, was most frequently employed by the subjects in responses to the harmonic variation. In many instances the subjects across all age levels perceived the addition of a chordal accompaniment as the entrance of a second piano or another instrument. For example:

> Started the same but when it gets to the middle, it starts the piano. (Age 7)
>
> Some of the music in the middle didn't sound the same because the piano was playing. (Age 7)
>
> An extra sound came in. The first one sounds like a piano, but the second one sounds more like a piano. (Age 9)
>
> Piano and a horn. (Age 9)
>
> A tapping drum and a piano. (Age 9)
>
> It sounded like three pianos. (Age 9)
>
> Pianos playing twice. (Age 13)

It is to be expected that concern with performance should be infrequent for the contour and interval variations, but it will be noted that such responses are of some notable frequency for three other variations. Thus, alterations in tempo, mode, and rhythm are sometimes construed as variations in performance of the music, e.g., as erroneous performance, rather than as variations in the music itself.

Simple description, Category B, was most often associated with variations in tempo, the addition of harmony, and rhythm. Apparently such stimulus deformations are relatively easy to detect and to describe in direct terms. However, it is somewhat surprising that change of instrument did not produce more simple descriptions.

Two sub-types of simple description were identified within Category B, one describing the spatial arrangement of the tones in responses to contour and change of interval, while descriptive responses to tempo and, to a lesser extent, rhythm, centered on temporal density and patterning of notes. Examples of these two types are as follows:

Interval:	Switched from high to low. (Age 13)
Contour:	Higher, they both had the same distance to go. (Age 9)
	Similar melody just upside down. (Age 13)
Rhythm:	It was squashed together. (Age 13)
Tempo:	More space in between the keys. (Age 9)
	It was drawn out more, more longer. (Age 13)
	Last couple of notes were stretched. (Age 13)

Category C consists of those responses which involve some affective response to the stimulus variation, and quite frequently those responses are of an evaluative nature, e.g., such terms as "ugly," "wicked," and "prettier" were frequent. Other affective responses implied aesthetic reactions to the music, e.g., "Added a little more gaiety" and "Sounded gladder at the end." Affective responses were found for all changes but instrument, but they were particularly frequent for mode.

Category D consists of those responses which we believe involve something closer to true imagery, and those responses are most frequent for the shift from major to minor mode, but they occur for all the variations, including instrument. Responses suggestive of synesthesia were identified by the use of such terms as "hazy," "smooth like down," and "sour." Also included in this category are those responses that convey the flavor of a situation. For example:

Harmony:	Sounded like church music. (Age 5)
	A circus thing. (Age 13)
Tempo:	Sounded a little about my church song. (Age 5)
	Sounded like a funeral was on. (Age 9)
Mode:	It was a little lonesome. (Age 9)

Finally, references to rhythmic movement, Category E, were most prevalent in response to rhythm and tempo variations, a finding which is quite to be expected.

The seven- and nine-year-old subjects gave the largest number of originally imaginative answers. This can be explained by the fact that the thirteen-year-olds more often used correct terminology while the five-year-olds were hampered by their lack of verbal facility. Over-all the subjects in the control training sessions tended to give more imaginative answers than did those in the experimental training sessions. Training sessions for the control group did not stress variation technique and the musical vocabulary was used incidentally and without explication. We believe this explains the greater use of imaginative responses by the control subjects. Table 13 summarizes the number of responses by age and training session.

Table 13

Verbal Responses by Age and Training Session

Musical Stimulus	5C*	5E*	7C	7E	9C	9E	13C	13E	Total
Contour	0	0	6	4	3	1	2	3	19
Interval	0	0	6	4	8	4	3	0	25
Harmony	6	3	18	21	41	38	5	4	136
Instrument	3	4	7	3	1	0	3	0	21
Mode	0	2	22	4	11	8	9	8	64
Rhythm	4	6	7	11	21	12	9	4	74
Tempo	5	4	21	9	16	18	10	6	89
Total	18	19	87	56	101	81	41	25	428**

*C = Control; E = Experimental

**Eight verbal responses were placed in two categories. See total in Table 12.

Discussion

Of particular interest for music education is the faulty perception induced by the addition of harmony and by the tempo change. Not only was the addition of harmony perceived as a change in timbre, it was also sometimes heard as a change in tempo. For example:

> Goes faster because of deep notes. (Age 7)
>
> Lower and faster. (Age 9)
>
> With the chords it made it go faster. (Age 13)
>
> When they harmonized it, it made it go longer. (Age 13)

Changes in tempo were perceived either as a change in the quantity of music or, conversely, by the amount of temporal space taken by the music. For example:

> That was a longer one; they had more on. (Age 7)
>
> The last part they put more music in. (Age 7)
>
> It was a little shorter. (Age 7)
>
> It was longer; the tune was longer. (Age 7)

An example of incorrect perception of the modal change is this response of a thirteen-year-old: "Played one key right after the other, real fast." The lowered scale degrees were perceived as being closer in pitch and performed faster.

Responses denoting a kind of situational imagery indicate that children are able to relate personal experiences to music. As fascinating as these responses are, they also pose provocative and disturbing questions for the music educator. Why is it necessary for children who are studying music in elementary and junior high school classrooms to rely upon inexact terminology from other experiences to describe musical stimuli? "They had company" might be picturesque, but it is scarcely an adequate response for a thirteen-year-old to make to a chordal accompaniment.

Why aren't children given the correct vocabulary as musical concepts are introduced? If a seven-year-old can identify a "contraction" and label it as such in language arts, why can't he also identify minor mode with its proper label? "The second one got tired" conveys an original image, but is it really a substitute for the term "minor mode?" We do not believe that children's propensity for creative and picturesque speech should be discouraged. We do believe that children should be given the vocabulary to facilitate classifying and labeling musical stimuli.

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CHAPTER VIII

EXPERIMENT III: CONSERVATION OF MELODY - SINGLE DEFORMATIONS

In our first two experiments only brief training sessions were held prior to the administration of the tasks. The children responded verbally to the tasks and there was some question that the inability of the younger children to verbalize their ideas interfered with the detection of true conservation responses.

Method

Experiment III of our series was desigened to obviate these difficulties in two ways: more frequent educationally relevant teaching periods were used and a response mechanism was designed to eliminate the necessity for verbal replies and so to negate age differences in the ability to verbalize.

Two classes each of kindergarten, second grade, fourth grade, and eighth grade subjects from an Evanston elementary and junior high school were randomly assigned to experimental and control training sessions. Each group had six 20 minute classes of instruction over a two-week period. The experimental subjects were exposed to instruction designed to elicit the invariant qualities from familiar songs in which variations of rhythm, tempo, mode, key, contour (inversion), harmony, and instrument had been made. The control group subjects

Table 14

Number of Subjects in Experiment III

	Kindergarten		Second Grade		Fourth Grade		Eighth Grade	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Control	10	10	12	8	10	10	10	10
Experimental	10	10	9	12	12	8	12	8
Total N	20	20	21	20	22	18	22	18

were exposed to more traditional instruction which incorporated the song bells and piano chording. (See Appendix D). The first author of this paper taught all sessions.

After the training sessions each subject met with an experimenter in individual 30-minute testing sessions. Two experimenters conducted the testing. The musical tasks for the test were four familiar songs, "America," "Pop! Goes the Weasel," "Twinkle, Twinkle Little Star," and "Yankee Doodle," in which the following systematic deformations had been made:

x_i	change of instrument
x_m	change of mode
x_t	change of tempo
x_h	change of harmony
x	no change
x_r	change of rhythm
x_c	change of contour (inversion)
x_d	different material
x_k	change of key (transposition)

The songs were performed on the piano and tape recorded. Each variation or different material was surrounded by a portion of the original. For example, part of the "Yankee Doodle" music went as follows: original - different - original - tempo - original - mode - original - transposition - original - different - original - harmony - original - contour - original, and so forth. Each song was played through completely in its usual form to provide a frame of reference before the variations were introduced. The variations on "America" were played once; those of the other three songs were played two times. (See Appendix E). Table 15 gives a resume of the testing sequence as experienced by each child.

Table 15

Experiment III: Testing Sequence

Piano version of melody of "America" in its entirety
Comments and instruction by experimenter
"America" with variations.

Piano version of melody of "Pop! Goes the Weasel" in its entirety
Comments and instructions by experimenter
"Pop! Goes the Weasel" with variations, repetition of "Pop! Goes the Weasel" with variations.

Piano version of melody of "Twinkle, Twinkle Little Star" in its entirety
Comments and instructions by experimenter
"Twinkle, Twinkle" with variations, repetition of "Twinkle, Twinkle" with variations.

Piano version of melody of "Yankee Doodle" in its entirety
Comments and instructions by experimenter
"Yankee Doodle" with variations, repetition of "Yankee Doodle" with variations.

The experimental set-up consisted of an upright masonite panel 24 inches high by 33 inches long, with three signal lights, two telegraph keys mounted on a board, and a set of earphones with microphone being visible from the child's side. On the experimenter's side there were earphones, a tape recorder, a timer, and control switches for the lights. In order to mask outside noises and to increase the interest and cooperation of the child,all communication between the experimenter and the child took place through the microphone-earphone headsets.

The subjects responded to the task by pressing one of the two telegraph keys which were differentiated in that one was black and the other white. The child was instructed to press the black key when he heard one of the critical variations, e.g., addition of harmony, change of mode, etc., and to press the white key when he heard music completely different from the original. He was to release both keys whenever he heard a repetition of the original music. The experimenter marked on a special score sheet the time of each key press and release, the time being read from an electrical second timer.

In order to establish a standard time for the occurrence of each variation and change, six music education juniors were tested on the apparatus. The critical time for the occurrence of a response was then taken to be the time range indicated by the quickest and slowest of the music students, e.g., if five students pressed the key at 52 seconds and the sixth at 54 seconds, then the span of 52 to 54 seconds became the standard. Any response after 52 seconds until the time of the next variation would be scored as correct. In determining the speed with which each child responded, 54 seconds would be regarded as the critical time from which deviations would be calculated.

Results

For the first analysis the mean performance scores for experimental and control groups on the four songs were computed. These are shown in Table 16. Then the scores of all subjects were summed across types of deformations in order to produce a single score for each song which could reasonably be assumed to represent each child's performance. Table 17 gives mean scores for the variables of grade level, experimental condition, and song.

Table 17

Mean Scores across Types of Deformations for Experimental Variables

Grade Level

	Kindergarten	Second	Fourth	Eighth
$\bar{X}$	14.03	40.18	44.83	50.31

Song

	America	Pop	Twinkle	Yankee
$\bar{X}$	24.05	38.84	46.00	40.45

Condition

	Experimental	Control
$\bar{X}$	37.62	37.06

The analysis of variance for data given in Table 17 is summarized in Table 18.

Table 16

Mean Performance Scores for Experimental and Control Groups on Four Songs

Group	America	Pop Goes the Weasel	Twinkle Little Star	Yankee Doodle	Total
Kindergarten Experimental	10.21	13.16	15.16	12.42	50.95
Kindergarten Control	9.68	15.63	23.80	12.15	61.26
Second grade Experimental	25.38	44.16	54.58	45.05	169.17
Second grade Control	26.05	36.72	48.28	41.25	152.30
Fourth grade Experimental	29.53	48.11	50.26	48.11	176.01
Fourth grade Control	31.85	49.86	50.58	50.32	182.61
Eighth grade Experimental	31.84	51.62	64.48	57.81	205.75
Eighth grade Control	27.89	51.47	60.86	56.50	196.72

Table 18

Analysis of Variance for Grade Level, Song, and Experimental Condition

Source	df	MS	F	P
Grade	3	39306.40	10.83	< .001
Condition	1	47.59		
Song	3	13347.59	23.52	< .001
G x C	3	392.77	1.08	ns
G x S	9	959.43	16.91	< .001
C x S	3	3.40		
Ss within groups	144	362.80		
G x C x S	9	110.72	1.95	<.05
S x Ss within groups	432	56.75		

It is apparent that children at different grade levels differed markedly in their performances, but inspection of means given in Table 17 reveals that the most marked change occurs between the kindergarten and second grade levels. There is a steady progression with age although it must be recognized that the grade interval between the fourth and eighth grade levels is twice as large as the others, and so the superiority in performance per year is not so great.

The songs also differ in mean score, but the difference between songs is almost completely accounted for by the low scores on "America," a finding partially attributable to the fact that "America" was played through only once because of its length and tempo so that scores on that song were bound to be lower.

There was not a significant difference associated with experimental treatment, and the triple interaction only barely reached significance. Moreover, the triple interaction does not appear to be interpretable, and the experimental treatment must be judged to have had little, if any, effect.

The interaction between grade level and songs was highly significant. It appears to have been accounted for by the difficulty of "America" for the older children, i.e., they did not do better than the younger children on it, and by the relative difficulty the fourth graders had with "Twinkle, Twinkle Little Star." Why "America" should have been so difficult it is hard to say, but on that song there was almost no difference in performance between second, fourth, and eighth graders. The difficulty may have stemmed from the fact that "America" was the first song for every child or perhaps it really presented some peculiar problems. We have no explanation for the problem the fourth graders experienced with "Twinkle, Twinkle Little Star."

In an attempt to elaborate and account for the findings, separate analyses of variance were performed for all of the nine stimuli. For every type of stimulus both grade and song produced highly significant differences, and for eight of the nine there was a significant interaction between grade and song. There were four interactions involving experimental condition with both mode and rhythm producing a grade by condition interaction and inversion and transposition producing a condition by song interaction. For both mode and rhythm experimental subjects were superior on "Pop! Goes the Weasel" and "Yankee Doodle" while control subjects were better on "America" and "Twinkle, Twinkle Little Star." In the case of inversion and transposition, control subjects were better on "Pop! Goes the Weasel."

One additional analysis of interest concerns the difficulty levels of the individual deformations and stimuli. The mean score per subject per deformation, i.e., across all four songs, was calculated for each stimulus. Since "Different" stimuli occurred ten times, the appropriate corrections were made to provide figures comparable to those for the deformations. The results are given in Table 19.

Table 19

Mean Accuracy Scores for Types of Stimuli across All Songs, Grade Levels, and Conditions

Type of Stimulus	Mean Accuracy
Different	2.81
Same	2.02
Mode	1.87
Harmony	1.87
Rhythm	1.69
Inversion	1.59
Instrument	1.57
Tempo	1.57
Transposition	1.34

Discussion

The results of this experiment are somewhat disappointing since the limited success of the brief instruction reported in Experiment II had suggested that a longer period might produce clear-cut and favorable effects on the conservation abilities of children. We are at a loss to explain or understand the failure of the experimental treatment in the present experiment. It is true that conditions of instruction were far from ideal, and attendance of children was not always at the level that might have been desired. Perhaps a longer period of instruction is not necessarily better if intensity must be sacrificed. Another important difference between the present experiment and the previous one is that in this case post-treatment testing often occurred at some considerable length of time following the treatment, e.g., as much as two weeks. Any effects of the treatment might have been diluted over time by intervening experiences.

We are not prepared at the present time to attempt to interpret the interactions which were found to be significant because they appear to depend, if they are in fact replicable, on intricacies of particular songs and the experiences of children at different age levels. Much more work will be necessary before differences between songs can be explicated.

Inspections of the means associated with the various deformations indicated surprisingly small differences in difficulty levels between them. The finding that transposition was seemingly the most difficult foil is probably attributable to the fact that changing the pitch level does not introduce enough variation to be considered as such. This is not unlike the finding of Reimers (See p. 32).

One final point to be made about the present experiment is that in it we employed a response mechanism that depended upon a motor response by the child and did not require any verbal response. Some of the problem may be attributable to the complexity of the task presented to the subjects since they had a number of response options to keep in mind. It may have been easy to make errors that would increase within cell variance, e.g., pressing a key by mistake, pressing one key instead of the other, etc. However, in a reliability check (split-half) of the groups which could be expected to be most variable over occasions, the kindergarteners was $r = .78$, which indicates that the proportion of truly random errors was not high.

At this time the understanding of the results of the present experiment must await a more detailed analysis of the data, e.g., examination of particular errors, and of further experimentation.

CHAPTER IX

EXPERIMENT IV: CONSERVATION OF MELODY - DOUBLE DEFORMATIONS

Method

Experiment IV of our series required responses similar to those of Experiment III in that the telegraph key response mechanism was again employed. In this experiment we were interested in finding out whether double deformations or variations would interfere with conservation of melody more than would be expected from their separate effects. Training sessions were brief and were confined to instruction in the immediate task. Each subject was given brief instructions before he took the test. (See Appendix F).

Seventy-one second, third, fourth, and fifth grade children from an Evanston elementary school were assigned either to Condition I or Condition II testing sessions.

Table 20

Number of Subjects in Experiment IV

	Kindergarten		Second Grade		Fourth Grade		Eighth Grade	
	Boys	Girls	Boys	Girls	Boys	Girls	Boys	Girls
Condition I	6	4	4	6	7	3	6	4
Condition II	6	4	6	4	2	8	5	5
Total N	12	8	10	10	9	11	11	9

Condition I subjects were required to press a white key when completely different music was heard and a black key when the music was only a variation of the original. The keys were to be released when the music returned to its original form. Condition II subjects pressed the black key only when completely different music was heard. No key was pressed for either the original or variations of the original.

Subjects and Conditions were counterbalanced in so far as possible in that three second grade subjects were tested under Condition I, followed by three under Condition II, then on to grade three and so forth.

The musical tasks for Experiment IV were the four familiar songs, "Twinkle, Twinkle Little Star," "Pop! Goes the Weasel," Yankee Doodle," and "America," in which the following double deformations had been systematically made:

x_{in-te}	change of instrument and tempo
x_{ha-rh}	change of harmony and rhythm
x_{mo-co}	change of mode and contour (inversion)
x_{in-mo}	change of instrument and mode
x_{te-rh}	change of tempo and rhythm
x_{ha-co}	change of harmony and contour
x_{te-ha}	change of tempo and harmony
x	no change
x_{in-co}	change of instrument and contour
x_{rh-mo}	change of rhythm and mode
x_{in-ha}	change of instrument and harmony
x_{te-mo}	change of tempo and mode
x_{rh-co}	change of rhythm and contour
x_d	different material

Three of the double deformations and completely different material occurred in each song. (See Appendix F). The songs were performed on the piano and tape recorded. Each double deformation or different material was surrounded by a portion of the original as in Experiment III. Each song was played through completely in its usual form to provide a frame of reference before the variations were introduced. The variations on each song were played twice. Table 21 gives a resume of the testing sequence experienced by each child.

Table 21

Experiment IV; Testing Sequence

Piano version of melody of "Twinkle, Twinkle Little Star"
in its entirety
Comments and instructions by experimenter
"Twinkle, Twinkle with variations, repetition of "Twinkle Twinkle" with variations.

Piano version of melody of "Pop! Goes the Weasel" in its entirety
Comments and instructions by experimenter
"Pop! Goes the Weasel" with variations, repetition of "Pop!" with variations.

Piano version of melody of "Yankee Doodle" in its entirety
Comments and instructions by experimenter
"Yankee Doodle" with variations, repetition of "Yankee Doodle" with variations.

Piano version of melody of "America" in its entirety
Comments and instructions by experimenter
"America" with variations, repetition of "America" with variations.

Results

Approximately the same scoring procedure as was used in Experiment III was used in this experiment. The same maximum score was theoretically possible in both experimental conditions.

Table 22 gives the mean values for the double deformations and conditions in the experiment. The analysis of variance for the data given in Table 22 is summarized in Table 23.

Table 22

Mean Accuracy Scores for Types of Stimuli by Condition across Grade Levels

Type of Deformation	SDV (Cond. I)	SD (Cond.II)
Same	3.32	3.87*
Different	3.14	3.21
Rhythm and inversion	1.22	1.72
Tempo and mode	1.85	2.20
Instrument and harmony	3.57	3.20
Harmony and inversion	2.30	2.30
Instrument and mode	3.10	3.22
Tempo and rhythm	2.02	2.42
Harmony and rhythm	2.92	3.17
Instrument and tempo	3.07	3.20
Mode and inversion	1.37	1.80
Rhythm and mode	2.60	2.62
Instrument and inversion	1.67	2.52*
Tempo and harmony	3.17	3.20

*The two experimental groups were significantly different in their responses to these stimuli. The analysis of variance for each of these stimuli is shown in Tables 24 and 25. The mean values for these stimuli by condition are: "Same": Condition II = 3.67; Condition I = 3.32 "Instrument and inversion": Condition II = 2.52; Condition I = 1.67.

Table 23

Analysis of Variance for Age Level, Experimental Condition, and Deformation

Source of variation	df	MS	F	P
Age	3	9.4865		
Condition	1	717.0031	13.57	$<.01$
Song	3	9.1365	1.01	
A x C	3	52.2781		
A x S	9	11.2392	1.34	
C x S	3	7.6615		
Subjects within A x C	72	52.8323		
A x C x S	9	12.9142	1.54	
S x Subjects within A x C	216	8.3980		

As indicated by Table 23 there was no significant effect associated with age in this experiment. This finding is not too surprising since in Experiment III most of the age difference seemed to be attributable to the difference between the kindergarten and eighth grade subjects while the second and fourth graders were not very different. Experiment IV involved only second through fifth grade subjects; hence, less age variance could be expected.

A significant overall difference was found between experimental conditions. Condition II in which the subjects had to respond only when they heard completely different music produced higher scores than did Condition I in which it was also necessary to respond to the variations.

120

Table 24

Analysis of Variance for Age Level, Song, and Experimental Condition for "Same Responses Only

Source	df	MS	F	P
Age	3	3.99		
Condition	1	607.75	41.45	.001
Song	3	.97		
A x C	3	12.89		
A x S	9	3.56	1.03	ns
C x S	3	2.89		
Ss within groups	72	14.66		
A x C x S	9	4.60	1.34	ns
S x Ss within groups	216	3.44		

(double deformations)

Table 25

Analysis of Variance for Age Level, and Experimental Condition for "Instrument and Inversion" Variation in "Yankee Doodle"

Source	df	MS	F	P
Age	3	.7000		
Condition	1	14.4500	8.1028	< .01
A x C	3	.7500		
Within groups	72	1.7833		

(double deformations)

3

Another analysis concerns the difficulty levels of the deformations. The mean score per subject per deformation was calculated for each stimulus. Since each type of double deformation occurred once in only one song, while "same occurred five times in each song, and "different" occurred once in each song, the appropriate corrections were made to provide comparable figures for the "same" and "different" stimuli.

Table 26

Mean Accuracy Scores for Types of Stimuli across Grade Levels and Conditions

Type of stimulus	Mean accuracy
Same	3.60
Instrument and harmony	3.39
Tempo and harmony	3.19
Different	3.17
Instrument and mode	3.16
Instrument and tempo	3.14
Harmony and rhythm	3.05
Rhythm and mode	2.61
Harmony and inversion	2.30
Tempo and rhythm	2.22
Instrument and inversion	2.10
Tempo and mode	2.02
Mode and inversion	1.59
Rhythm and inversion	1.47

Discussion

It is not surprising that the subjects who had only to monitor the completely different music obtained higher scores. Their task was a simple one; a perfect performance would have required only one response for each song. On the other hand, as there were only two response alternatives, an "error" would have counted more heavily. Failing to respond to a difference or erroneously responding to a stimulus repetition would have counted as a two-point error since there was no "variation" alternative. In addition the subjects did not know that only one response was required, and they did have to decide whether a variation was still the same music or was a different stimulus. That their performance was so much better than Condition I subjects suggests that they could recognize variations rather well. It is highly possible that the requirement of a separate response to variations is unnecessarily confusing and simply increases opportunities for errors to occur. This would seem to suggest that response requirements be kept as simple as possible.

Inspection of the means associated with the various double deformations again indicated small differences in difficulty levels between them. Instrument and harmony in combination was the easiest foil for our subjects. In Experiment II these variations introduced singly also proved to be simple foils.

CHAPTER X

EXPERIMENT V: A COMPARISON OF RHYTHMIC AND TONAL CONSERVATION

(This experiment was done in collaboration with Mr. Philip Young)

In most of our previous work we have concentrated on conservation of tonal pattern because that was easiest and most obvious to work with. In order to study tonal conservation, one need only produce systematic deformations in already existing music. For study of rhythmic conservation it is necessary to write several new tonal patterns for each rhythm pattern to be studied. However, it seemed highly desirable that our previous work be extended to a musical problem other than tonal conservation, and we chose to attempt a comparison between ability of children to conserve tonal pattern and to conserve rhythmic pattern. To that end brief musical phrases were prepared (see Appendix G) in which either tonal pattern or rhythmic pattern was kept invariant. Six different tonal patterns were prepared, three major, two minor, and one atonal pattern. Six different rhythm patterns were also prepared. For the tonal conservation task each pattern was deformed by changing the rhythm, and four items were available for each pattern, twenty-four in all. For the rhythmic conservation task, each basic rhythm was presented in the context of major, minor, and atonal patterns. Again there were twenty-four items. In the case of both tonal and rhythmic patterns, within any set of four, there were usually three repetitions of the original pattern and one completely different pattern. However, for both tasks one of the six sets of four items consisted of four repetitions of the original.

The music was recorded on tape with the piano as the instrument, and answer sheets were prepared (see Appendix G) so that the children might be tested in small groups. Since it seemed to us that a variety of considerations indicated that conservation might be enhanced by some method of augmenting the original perception and the memory of the children, half of the children were provided with a visual representation of each of the musical stimuli. The answer sheets were prepared so that half of them had a visual pattern corresponding to the musical pattern. For tonal pattern more or less conventional notation was used with darkened ovals being placed on a five line staff. Rhythm was presented visually by horizontal lines of varying length. At each of four grade levels, second, third, fourth, and fifth, 20 children were tested with and without visual help, a total of 160 children in all.

Method

Subjects

The subjects were 160 children ranging in age from 7 to 11 years, drawn from the second, third, fourth, and fifth grades of an elementary school. Forty children from each grade level comprised the sample, and within each grade level the number of boys and girls was approximately equal. Subjects were drawn randomly by grade, and no restrictions other than normal hearing as judged by the classroom teacher were placed upon participation in the experiment. Although no socioeconomic data was collected for the sample, the neighborhood surrounding the school is large middle class.

Materials

A tape recorder was used to present the stimulus materials. Both the instructions and the tonal and rhythm patterns played on the piano had been recorded. Half of the subjects in each grade were provided with one of two forms of the answer sheet: Form A without notation, or Form B with notation. All answer sheets contained twelve items--six rhythm pattern and six tonal pattern items. On Form A the six rhythm and six tonal items appeared on different pages, and under each item number were the letters a, b, c, and d denoting the four examples that were to be judged either same as or different from the model pattern played for that item. Judgments were made by marking an "X" in a box beside the word "same" or "different" which was typed next to the letter of the example pattern. The method of marking Form B was the same as Form A. The format of Form B was also the same except that musical notation symbolizing the model tonal pattern and schematic notation symbolizing the model rhythm pattern appeared on the answer sheet next to each item number. (See Appendix G)

Design

A 4x2x2x2 factorial analysis of variance with repeated measures on the last factor constituted the design of this experiment. The variables were: four grade levels (2, 3, 4, 5), two orders of presentation (rhythm then tonal, and vice versa), two forms of the answer sheet (with and without notation), and two measures of conservation for each subject (rhythm conservation and tonal conservation). Within each grade level the variables of order and form were orthogonal.

Procedure

Subjects were tested in groups of 10 and were seated at tables in the form of a semi-circle around the tape recorder and the experimenter. After filling out a brief personal information form, the subjects listened while the experimenter explained the nature of tonal and rhythmic patterns. For all subjects, whether or not they were to receive Form B, the experimenter demonstrated the constancy of tonal and rhythm patterns deformed on an irrelevant dimension by using pictures of notation similar to those on Form B. By so doing, all subjects should have been equally familiar with the notation used in the experiment.

After listening to the experimenter's explanation, the subjects made same-different judgments for four examples of a sample item, and received immediate feedback on their performance by hearing the correct answers read on the tape. Then, after final questions the subjects proceeded to either the tonal or rhythm patterns. (These general instructions were carried out before both the rhythm and tonal phases of the experiment.) For each pattern the original stimulus was played twice in immediate succession, followed by the four examples at an approximate 5 sec. rate. As the subjects progressed, the experimenter would verbally introduce each example by saying its letter to aid the subjects in keeping their place.

In summary, subjects heard six different model tonal patterns and six different model rhythm patterns each played twice. Following each model were four examples (a, b, c, d) which could either be the same as or different from the model. Subjects responded "same" or "different" to each example, thereby making 24 judgments each for the tonal and rhythm sections, or 48 judgments in all. Half of the subjects in each grade level had the advantage of viewing notation for each model placed on the answer sheet as they made their judgments of each example, while the other half did not. Likewise, half of the subjects in each grade level received the tonal patterns first, while the other half received the rhythm patterns first. The form of the answer sheet a subject received and the order of presentation was assigned randomly to subjects within a grade level.

Scoring

Each subject received a score reflecting the number of correct responses he made for each of the two types of tasks. In addition, for other analyses, the number of errors made in individual items for subjects in various experimental groups was counted.

Results

The correct responses of various experimental groups were subjected to a repeated measures analysis of variance (2). Table 27 presents the mean values for experimental groups, and Table 28 gives a summary of the analysis of variance. First, we would note that, as expected, children at different grade levels differ in accuracy of performance, with the older children being superior. However, as is shown by the Duncan Multiple Range Test in Table 29 , third graders are significantly better than second graders, and fourth graders are significantly better than third graders, but there is not a significant superiority of fifth graders over fourth graders. Whatever skill or understanding which is involved in this task is existent by grade four, although it must be noted that performance even at grade five is considerably below a perfect 48. It is of possible interest here that Petzold (1) found little improvement in aural perception beyond the third grade level.

Table 29

Means for Four Age Groups
on
Rhythm-Tone Conservation Task,
with
Results of Duncan Multiple Range Test

	Grade			
	Second	Third	Fourth	Fifth
Mean	28.38	31.48	34.00	35.03

Means underlined by same line are not statistically significant.

Table 27

Mean Values for Experimental Groups and Variables in

Experiment V

	Grade					Total		Total for
Tonal	Second	Third	Fourth	Fifth		for Task		Condition
With Visuals	15.00	17.50	18.45	18.75	Tonal	16.76	Visual	34.40
Without Visuals	14.10	14.75	17.45	17.10				
Rhythm								
With Visuals	13.95	17.50	17.60	17.85	Rhythm	15.46	Without Visual	30.04
Without Visuals	13.45	13.20	13.50	16.40				
Totals	28.38	31.48	34.00	35.03				
Grand Total						32.22		

Table 28

Analysis of Variance Summary for Experiment V

Source	df	MS	F
Grade	3	175.84	8.43**
Order	1	.25	--
Form	1	380.63	18.25**
Grade x Order	3	13.15	--
Grade x Form	3	36.72	1.76
Order x Form	1	190.65	9.14**
Grade x Order x Form	3	24.16	1.16
Ss x Grade-Order-Form	144	20.86	--
Measures (Rhythm, Tonal)	1	133.69	18.02**
Measures x Grade	3	23.85	3.17*
Measures x Order	1	8.59	1.16
Measures x Form	1	12.96	1.75
Measures x Grade x Order	3	.66	--
Measures x Grade x Form	3	7.77	1.05
Measures x Order x Form	1	5.33	--
Measures x Grade x Order x Form	3	4.41	--
Measures x Ss x Grade x Order x Form	144	7.42	--
Total	319		

** $p < .01$
* $p < .05$

As shown by the analysis of variance and the means in Tables 27 and 28, tonal conservation was more accurate than rhythmic, but the difference is not great, amounting only to about one item out of 24. We had anticipated that rhythmic conservation would be considerably more difficult.

There is also a significant difference attributable to the presence or absence of the visual stimuli, but that experimental variable also interacts with order of presentation of the tonal and rhythmic tasks. While availability of visuals is associated with better performance, the interaction as graphed in Fig. 5 and given in Table 30 shows that the effect of visuals is largely limited to those subjects receiving the rhythmic task first. The reason for that totally unexpected interaction is not at all clear, but one hypothesis is that it is confusing to go from conventional (tonal) notation to the type of straight-line notation used for rhythm. It is important to note, however, that the effect of visuals is not different for the rhythmic and tonal tasks. Visual stimuli are equally helpful or non-helpful for each task, in whichever order they are presented.

Table 30

Means for Order X Experimental Group (Form) Interaction

	Experimental Group	
Order	Without Visuals	With Visuals
Tonal-Rhythm	31.53	32.80
Rhythm-Tonal	28.55	36.00

There is also a significant interaction between grade level and type of task (See Table 31). The portrayal in Fig. 6 shows that the difference between rhythm and tonal tasks is quite marked at grade 4, a finding for which we have no ready explanation. Perhaps the difference is attributable to some aspect of the music curriculum, but it may also just be one of those mystifying perturbations that occasionally plague all research.

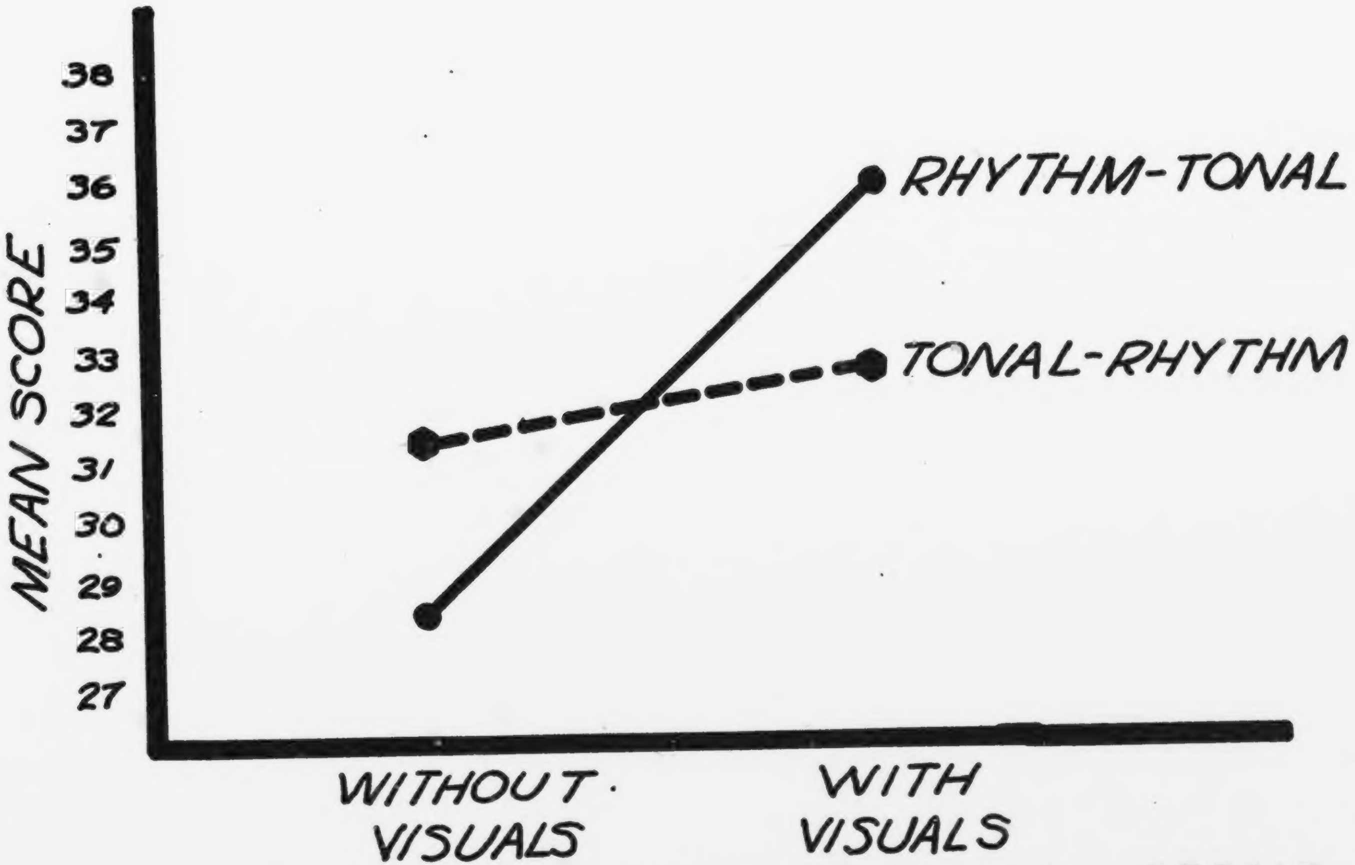

FIG. 5 ORDER X EXPERIMENTAL GROUP INTERACTION (FORM)

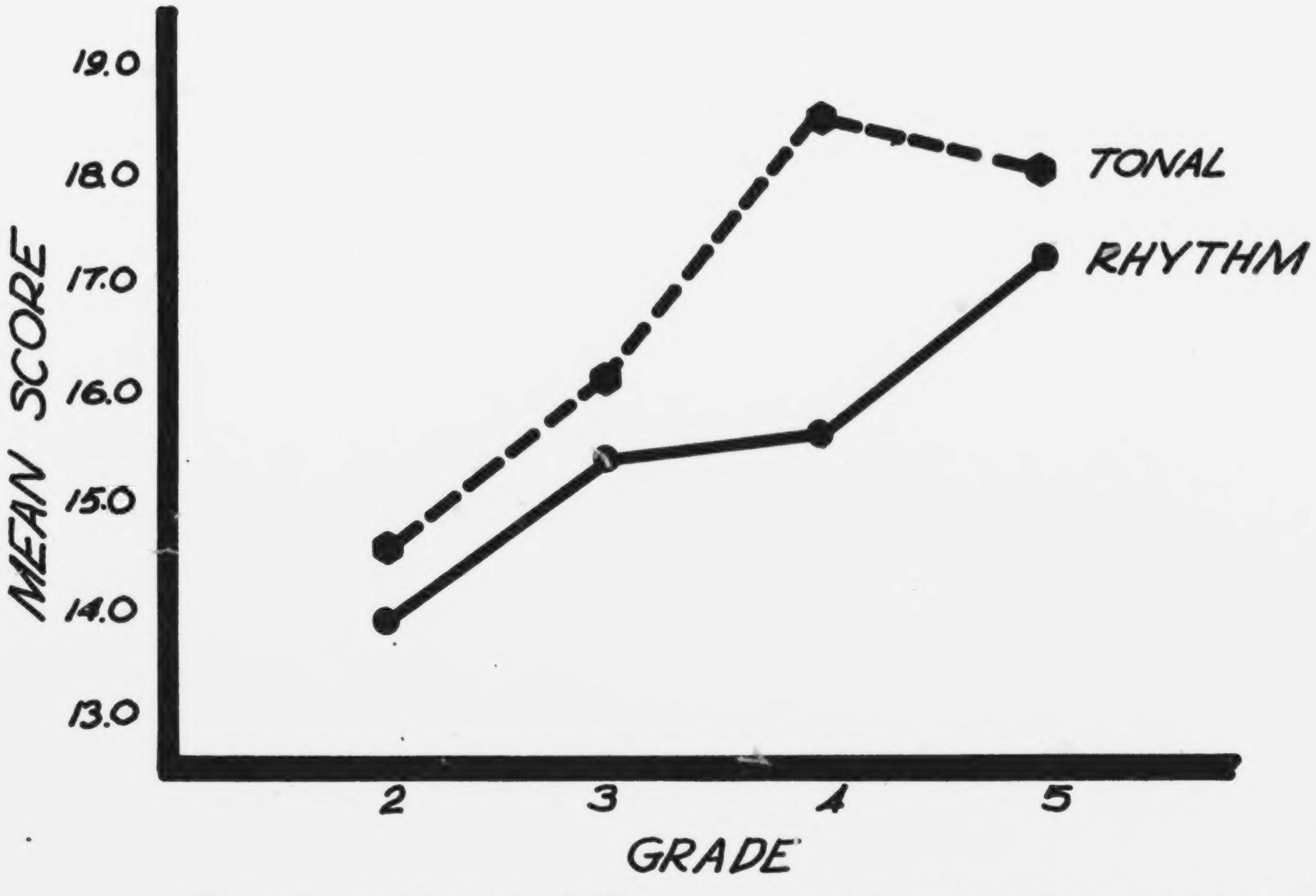

FIG. 6 MEASURES X GRADE INTERACTION

Table 31

Means for Measures X Grade Interaction

Measure	Grade Second	 Third	 Fourth	 Fifth
Rhythm	13.83	15.35	15.55	17.10
Tonal	14.55	16.13	18.45	17.93

Analysis of errors on individual items

Errors made by the children were counted separately for individual items, both within and across all four grade levels. Then mean number of errors was calculated for different types of stimuli with the results as reported in Table 32. In the case of the tonal conservation task the only discrimination among items that was possible was between those items which represented repetitions of the tonal pattern of the original stimulus and those items which were different from the original. As can be seen from the results, there was relatively little difference in difficulty of the items. In one

Table 32

Mean Number of Errors on Types of Items Across Age Groups

	Items Same as Original	Items Different from Original	
Tonal task	50.10	44.60	
Rhythm task	57.63	53.80	
Rhythm task	Items in Major Mode	Items in Minor Mode	Atonal Items
	57.00	46.43	66.88

important way that finding is encouraging for the nature of the experimental procedure permitted the operation of a response bias. Thus, children might have been inclined simply to mark either "same" or "different" for all the items. However, in that case the items which were in fact either the same or different should have elicited a differential number of errors. That no strong tendency of that nature occurred argues against the response bias notion.

In the case of the rhythm conservation task it was possible to categorize individual items as being different from the original or else as being repetitions of the original with either a major, a minor, or an atonal pattern. As is shown by the results, for the rhythm task the different items were again no more difficult than repetitions, but there is a suggestion that rhythm conservation is affected by the tonal pattern which provides the context. As somewhat anticipated, the atonal items were more difficult, but rather surprisingly the minor patterns produced better rhythm conservation than the major patterns.

We also analyzed errors made by children at the different grade levels with the thought that some kinds of items might be particularly easy or difficult at various grade levels. However, while there were some isolated items which seemed to have different patterns of difficulty across age groups, there were no findings of sufficient consistency to be interpretable. By and large the items which were relatively most difficult for the fifth graders were also the most difficult for the second graders.

Finally, the errors made on different items were examined to determine whether the visuals were differentially helpful for different items, but there was no consistent pattern. While the use of visuals seemed to reduce errors markedly on some items, there was no obvious way in which the items differed that would make it possible to say just what the specific effect of the visuals was.

Discussion and Conclusions

One of the suppositions on which the experiment was based was that tonal and rhythmic conservation might be of different difficulty, and indeed they were. However, it is interesting that the difference was in fact slight. Tonal conservation proved significantly but only slightly easier than rhythm. It is difficult to say just how much experience children have with musical conservation-type stimuli, but the early music curriculum usually places substantial stress on rhythm. It seems likely that informal musical training, e.g., in the home, on television, places much more emphasis on tonal pattern and provides more opportunities for learning tonal conservation. For example, it is not at all unusual to hear a commercial jingle played at different tempi, in simple and embellished forms, with different rhythms, etc. It is rare to find such systematic presentations of rhythm patterns.

In truth it must be admitted that we have no way of determining whether rhythm or tonal conservation is "really" the easier. The problem is that there is no way of knowing independently of a subject's response just how difficult any particular tonal or rhythm stimulus is to apprehend or to remember. For example, to take a very simple case, suppose we have a two note tonal pattern consisting of an a and a c. What kind of a rhythm pattern would be comparable to the simple tonal pattern we have suggested? For example, would a whole note followed by a quarter note be comparable, or would a pattern of three quarter notes in a row be comparable to such a simple tonal pattern? Obviously, there is no way of deciding; hence, there can be no way of making a direct determination of the difficulties of tonal and rhythm conservation. The best we can do is to describe certain patterns and their difficulty levels, as we did in this experiment. It is only in a very tentative way that we can conclude anything about the relative difficulty levels of the two kinds of musical experience.

An important aspect of our experiment was the determination of the effect which the presence of visual representations of the stimuli might have on conservation. It seems reasonable that by utilizing the cues to perception and to memory which can be provided by visual stimuli, conservation responses might be enhanced. And, as we see from this experiment, that conclusion is justified. It is also necessary to conclude from this experiment that the effect of visuals is not general. That is to say, we cannot expect that visual stimuli will be especially helpful for all kinds of conservation tasks, and as yet it is difficult to say for just what tasks they will be helpful. The finding obtained here was sufficiently complex and unexpected that it needs further exploration before we come to any firm and final conclusions.

We are intrigued by the finding that rhythm conservation seemed to be easiest when the tonal context was provided by a tonal pattern in a minor key. We had anticipated that rhythm conservation would be more difficult for atonal tasks, as was the case here. We had not anticipated that the minor key items would be easiest. At present, we do not know how to explain the results, but there are two things we would like to point out. First of all, there are many children's songs, including folk songs, which are written in or which have portions in minor keys. Children may not find the minor keys so unusual as we might think. Secondly, it is possible that a minor key helps to enhance the perception of a rhythm pattern by making the rhythm pattern stand out some way. Perhaps for some tonal patterns in a minor mode, the tonal pattern itself is not as overwhelmingly salient as is a tonal pattern in a major mode, and thus other aspects of the musical experience are easier to hear and to retain. Or, to put it in Piaget's terms, decentration with regard to tonal pattern may be easier if the pattern is in a minor key. Again, further research is needed on these points before we can make more than the most tentative suggestions.

Finally, we would point out that once again, as expected, but in a gratifying way, we obtained a gradient associated with age so that the older children do better on our tasks. That is certainly not a very remarkable finding, but it is one which we have found consistently in our research. And, once again, we would note that the fifth grade children did not do very much better than the fourth grade children. Most of the improvement which we may assume to take place on this task seems to occur before the fifth grade. We now want to determine how much additional improvement can be expected beyond fifth grade to the adult level.

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CHAPTER XI

CONCLUSIONS AND RECOMMENDATIONS

The purpose of this series of experiments was to study the relevance of the Piagetian concept of conservation to musical learning. Essentially, conservation in musical learning refers to the ability of an individual to retain the invariant quality, i.e., the sameness of a complex musical stimulus even though variations or deformations are made in its presentation.

Five experiments were designed and administered to 679 subjects of elementary and junior high school age. For each experiment original musical tasks were devised. The subjects were tested for their ability to conserve an invariant aspect of the musical stimulus. Four of the experiments were preceded by a brief period of instruction; one experiment was preceded by six instructional periods spread over two weeks.

Conclusions

Findings across four experiments indicate that performance on the tasks is progressively better as one goes from the younger to the older age groups.

Conservation of meter and rhythm pattern is more difficult than conservation of tonal pattern.

Instruction can aid a child to decenter his perception from dominating aspects of a musical stimulus. In Experiment II the effect of brief instruction to facilitate conservation was most marked at the five-year-old level. However, Experiment III did not show a significant difference between subjects exposed to experimental training in conservation skills and those who were not.

Subjects across age groups lacked the musical vocabulary with which to describe and discuss the musical stimuli.

Change of instrument, tempo, and the addition of harmony did not interfere as much with conservation as did change of mode, contour, and rhythm pattern.

In Experiment V third graders were significantly better than second graders; fourth graders were significantly better than third graders; but fifth graders were not significantly better than fourth graders. This seems to indicate that a kind of plateau in music conservation skills as measured by these tasks is reached by the fourth grade.

The presence of visuals in Experiment V made a significant difference with the effect being more pronounced for those subjects who received the rhythm tasks first.

Patterns in minor mode produced better rhythm conservation than did the major or atonal patterns.

The initial teaching of musical structure may best be pursued through the study of familiar music. (See Appendix H)

Recommendations

Although our data are not conclusive enough for us to make any definitive recommendations about music education, we do believe that our results show that even young children are capable of comprehending fairly complex musical concepts. We may be doing students a disservice by bringing them along too slowly in their music education. Concepts such as inversion, mode, and rhythm pattern may well be teachable to children at younger ages than we imagined. We think that it is a also important that music education involve more active participation and experimentation by the student. Too much of what passes for music education involves only very passive participation of the student and discourages any experimentation. Children should have the opportunity to create and experiment with music in a very active way. By their own creation and experimentation they may learn that such aspects of music as tonal pattern, rhythm, tempo, and intervals are equally as plastic but immutable as a quantity of clay.

Specific recommendations resulting from our data are as follows:

1. There needs to be a better match between the music curriculum and children at the age levels studied. The principle which is obvious but which is not often enough honored is that a musical curriculum should be developed along the necessary lines to provide proper musical experiences in learning for children rather than

along the lines of those things which are simply easy to teach. Our investigations showed substantial differences in the difficulty levels of different kinds of musical concepts, some of which may be intrinsic to the material but some of which may also be attributable solely to the failure to consider the concepts in the usual music curriculum.

2. More emphasis should be placed on active experimentation with rhythm and meter in the elementary schools.

3. Instruction which considers the variation of musical patterns and themes through a systematic study of variation technique should be incorporated in the classroom. (See Appendix H)

4. From the beginning children should be taught the proper musical terminology and vocabulary.

5. More instruction should be given in musical mode, contour changes (inversion), and rhythm pattern.

6. A system of notation to clarify the aural stimulus should be used as early as age seven.

In addition to the preceding recommendations we would like to suggest that further research is needed in the following areas:

1. The musical tasks need further refining for administration to older adolescents and adults.

2. The musical tasks need to be used as models for students' active experimentation and creativity with the efficacy of this type of instruction being submitted to more rigorous research.

3. Perception of patterns in major and minor mode and atonal patterns needs further study across age levels.

4. The fourth and fifth grade music curricula need to be examined for differences in concepts and musical materials studied.

APPENDIX A

R. Francès La Perception de la Musique

Paris: Librairie Philosophique J. Vrin. 1958

403 pp

APPENDIX B

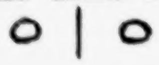
EXPERIMENT I

Musical Tasks

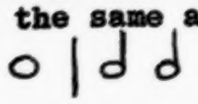
Task I. Conservation of Duration.

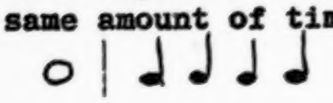
This task is analogous to the Piagetian "sausage" experiment to test for conservation of quantity. In this experiment the identity of two lumps of plasticine is affirmed. One lump is then divided into two smaller lumps and the child is asked whether or not the same amount of plasticine is present in the two smaller lumps as in the one larger lump. Then the two lumps are further sub-divided into four smaller lumps and the same type of question is posed.

Task I was designed to measure conservation of duration. Two successive tones were sounded on the piano, A 440, for an equal duration of time, MM ♩= 92. The amount of time consumed by the second tone was then subdivided into shorter units and the subjects were asked to compare the amount of time used by the shorter tones with that used by the one longer tone. The task consisted of three examples.

Ex. #1. "I will play two tones for you. Does the second tone take the same amount of time as the first tone?" 

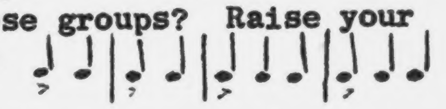
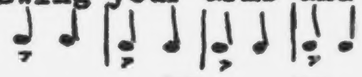
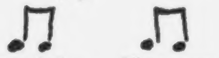
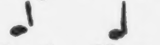
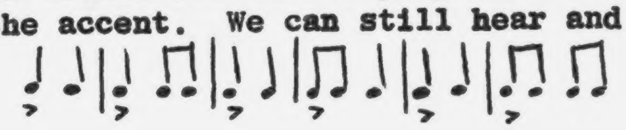
(The experimenter helped the subject to affirm the identity of the two tones.)

Ex. #2. "Suppose I play two shorter tones. Will the two shorter tones take the same amount of time as the one long tone?"  "Why is that?"

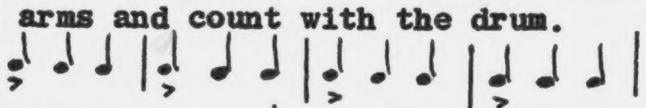
Ex. #3. "Now suppose I play four short tones in place of the one long tone. Will the four short tones take the same amount of time as the one long tone?"
 "Why is that?"

Task II. Conservation of Meter.

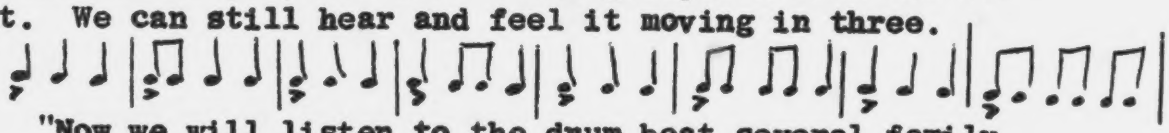
Task II logically follows from Task I and is an attempt to ascertain stages in children's ability to conserve meter when the component elements of the musical measure vary in duration. In this task durational values are presented in either duple or triple meters. The temporal unit of a measure within a specific meter is kept constant; the distribution of note values within the measure varies. Both aural and visual stimuli were presented to the subject. The task was introduced in story form. The story was not recorded.

> "When listening to several musical sounds which are called tones, certain tones will be louder than the others. The loud tones which sound like 'booms' are called accents in music. Can you tell which is the louder or accented tone in these groups? Raise your hand when you hear the accent. 
>
> "Now you try it." (Subject is to reproduce accent patterns on sticks.)
>
> "Now these tones can be spaced in groups of two or three. We could call them 'family groups.' Some families have only two, , one-two. Listen to the accent
> Dad Mom
> followed by the softer tone. We say that it is moving in two's. Clap or swing your arms and count with the drum.
> 
>
> "Now, if we say,  , one' un-two'oo,
> Daddy Mommy
> we again have a family group of two because the same amount of time was taken as in  , one-two, but the tones
> Dad Mom
> were shorter and so we had to use more in order to take up the time. Listen to the drum as it plays shorter tones grouped around the accent. We can still hear and feel it moving in two. 

"You may live in a family of three, ♩ ♩ ♩ ,
You Dad Mom
one-two-three. Listen to the accent followed by the two softer tones. We say that it is moving in three's. Clap or swing your arms and count with the drum.



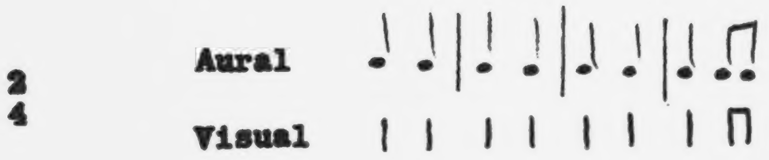
"Now suppose we say, ♩ ♫ ♫ , one-two'oo-
You Daddy Mommy
three'ee. Here again we have a family group of three because the same amount of time was taken as in ♩ ♩ ♩ ,
You Dad Mom
one-two-three; but some of the tones were shorter and so we had to use more in order to take up the time. Listen to the drum as it plays shorter tones grouped around the accent. We can still hear and feel it moving in three.



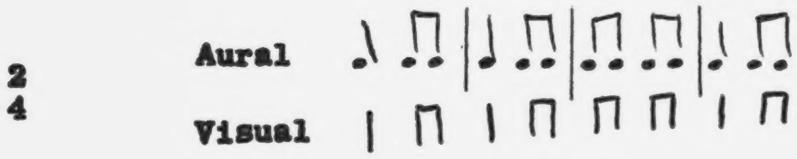
"Now we will listen to the drum beat several family groups. I want you to tell me if it is a family group of two or of three. Does it move or swing in two or three? It will help you to answer if you try to clap or swing your arm with the beat, like this." (Experimenter demonstrates). "Be sure to listen for the louder or accented tone. Remember some of the tones will be shorter so that we can use more to take up the time between the accents."

The subject was asked to discriminate between duple and triple meter. The six examples had been played at a tempo of MM ♩ = 92 on a ten-inch Weather King drumhead and recorded. Examples 1, 2, and 5 are in duple meter, while Examples 3, 4, and 6 are in triple meter. The subject was directed by the tape to "Example #1," followed by the example. Each example was repeated, "Here it is again," and so forth. The subject answered verbally as to whether each stimulus pattern was in two or three and why. Each pattern was firmly established before more variety in the subdivision was introduced. Again this is similar to the Piagetian "sausage" experiment.

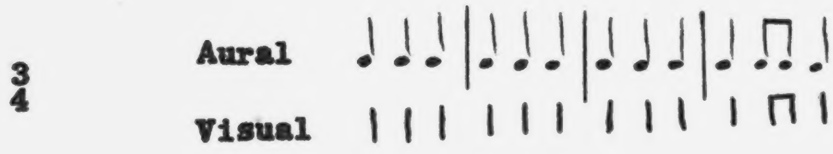
Example #1


2
4
Aural
Visual

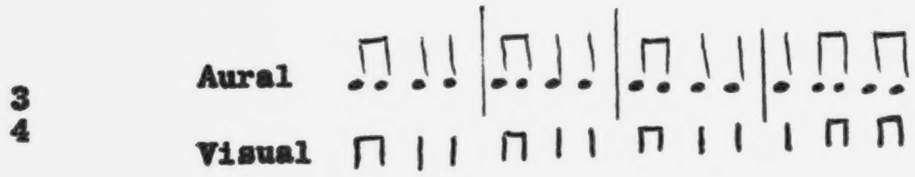
Example #2


2
4
Aural
Visual

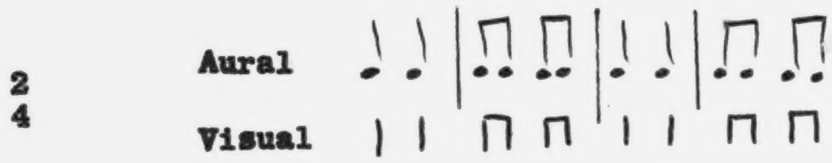
Example #3


3
4
Aural
Visual

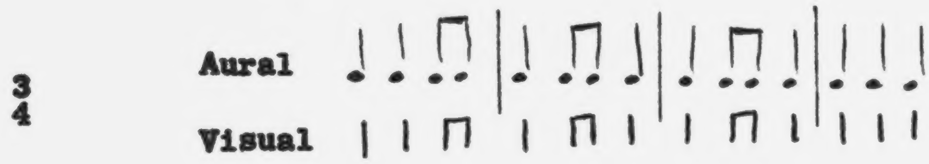
Example #4


3
4
Aural
Visual

Example #5


2
4
Aural
Visual

Example #6

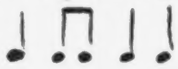
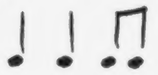
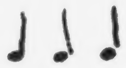
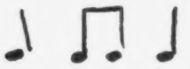
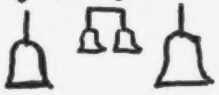
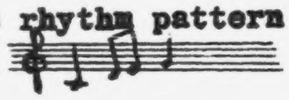
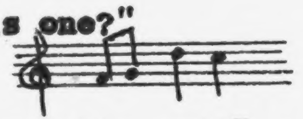
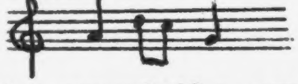

3
4
Aural
Visual

Task III. Conservation of Rhythm Pattern.

Piaget views concept development as the stabilizing of a specific concept within contextural changes. Task III is concerned with the conservation of the distribution of rhythmic elements within a musical measure. In this task the rhythm pattern remains constant; the tonal pattern varies.

Task III consisted of six examples of four items each. An attempt was made to separate tonal memory from conservation by having one item in each example an exact replication of the stimulus. The position of items within each example was randomized.

A story depicting a learning situation was again the setting for the task. The story was not recorded. It was read by the Experimenter to each child individually. Tone Educator School Bells were used in the story-demonstration. Both aural and visual stimuli were presented to the subject.

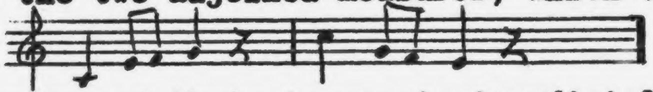
> "Now we are going to make-believe that we are visiting a classroom. We will hear a teacher teach four of the children in her class, John, Mary, Bill and Sue, how to play rhythm patterns on a drum. A rhythm pattern is an arrangement of long tones and short tones." Listen to these rhythm patterns."
>
>   
>
> "Do you understand what a rhythm pattern is? I will play each rhythm pattern two times so that we can learn it with the children. You can beat it quietly with me on the table. Now the teacher will play the rhythm pattern on one key of the piano. After this the children will play the rhythm patterns, but they do not have to stay on one key. They can make up little songs and play any keys of the piano that they want, as long as they play the same rhythm pattern."
>
> "For example, here is a rhythm pattern." 
>
> "This is its picture." 
>
> "Does this rhythm pattern sound the same?"
>
> 
>
> "Does this one?"
>
> 
>
> "What about this one?"
>
> 
>
> ("How does it sound the same" or different, according to child's answer was asked after each pattern.)

"Now some of the children might also make a mistake and play the wrong rhythm pattern. You be the judge. After each child plays the rhythm pattern on the piano, you tell me if he played it right, just like the teacher, or if he played it wrong."

After each answer ask: "How does it sound the same?" or
"How does it sound right?"
"How does it sound different?" or
"How does it sound wrong?"
(depending on child's answer)

Task III, Conservation of Rhythm under Deformation of Tone, bears a remarkable resemblance to an example cited in Ernst Mach's book, *Contributions to the Analysis of the Sensations* (1897).

> That a definite, specific time-sensation exists, appears to me beyond all doubt. The rhythmical identity of the two adjoined measures, which vary utterly in the order of their tones, is *immediately* recognised. We have not to do here with a matter of the understanding or of reflexion, but with one of sensation. In the same manner that bodies of different colors may possess the same *spatial* form, so here we have two tonal entities which, acoustically, are differently colored, but possess the same *temporal* form. As in the one case we pick out by immediate act of feeling the identical temporal components, or the sameness of the rhythm.[1]



Our task was designed, however, to determine whether or not conservation is involved and to determine developmental stages in the ability of children to detect an invariant rhythm pattern.

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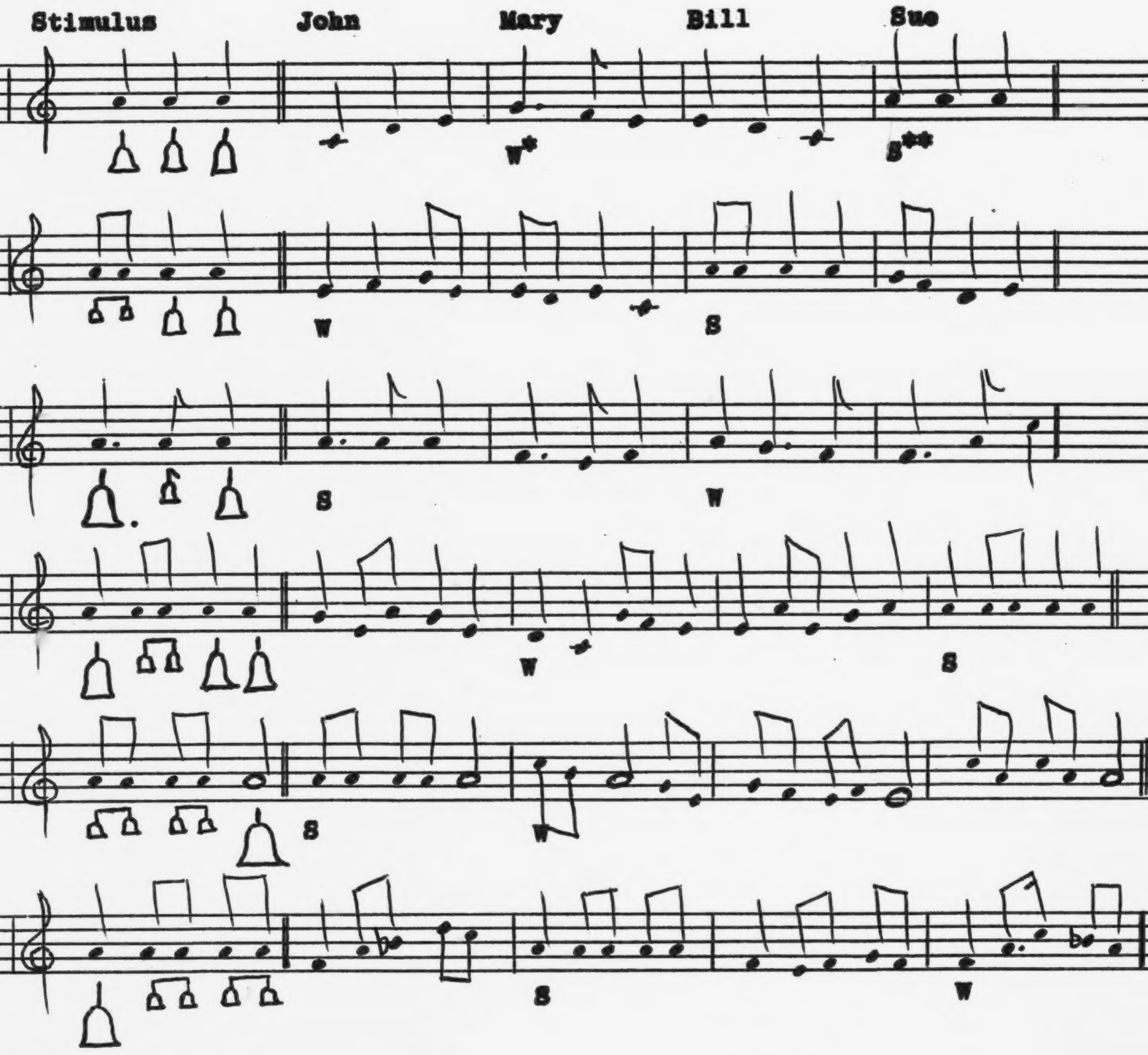
[1] Mach, Ernst. *Contributions to the Analysis of the Sensations.* Chicago: The Open Court Publishing Company, 1897, p. 110.

Task III


Stimulus
John
Mary
Bill
Sue
W*
S**
W
S
S
W
W
S
S
W
S
W

*W - Wrong

**S - Same as Stimulus

🔔 - Visual

Task IV. Conservation of Melody

The reciprocal rhythmic devices of augmentation and diminution are used by composers in working out musical ideas. We believe that a characteristic aspect of musical intelligence is the ability to identify a recurring melody when the durational values are either augmented or diminished. The Piagetian tasks designed to study the psychologic development of concepts of time and speed in children served as models for the development of Task IV.

Task IV consisted of six examples selected from Bartŏk's piano music For Children (1). Examples #1 and #4 played the melody in augmentation; Examples #2 and #6 played the melody in diminution. In order to separate tonal memory from conservation Example #3 was an exact replication of the stimulus. Example #5 used an entirely different tune. The order of examples had been randomized. No visual stimuli were used in Task IV.

The following story was presented to each subject.

> "Do you know what a tune is?" (Explain)
> "Now we will hear the teacher play the same tune two times on the piano. Listen carefully so that you can hear that the second tune is just the same as the first tune." (Play tape) "Does it sound the same?" (Wait for S's answer)
> "Now the teacher plays the second tune like this." (Play tape) "Is it still the same tune as the first tune or is it a different tune?" (Play tape again) "How is it the same?" "How is it different?" "Is there anything special about the speed?"

The last three questions depended upon the subject's answer to the preceding question.

Task IV

The following copyrighted material has been removed:

Béla Bartók, Piece No. 5 (Measures 1-4, both clefs), in For Children, Vol. I (Lynbrook, New York: Boosey and Hawkes, Inc.), p. 5.

__________, Piece No. 15 (Measures 1-4, treble clef), in For Children, Vol. I, p. 14.

__________, Piece No. 3 (Measures 1-4, treble clef), in For Children, Vol. II, p. 3.

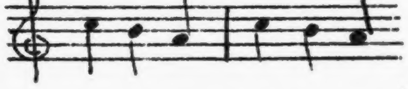
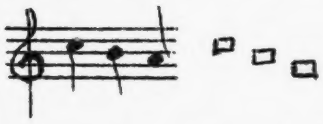
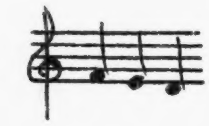
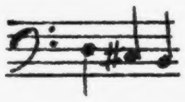
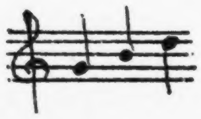
__________, Piece No. 29 (Measures 9-12, both clefs), in For Children, Vol. I, p. 28.

__________, Piece No. 20 (Measures 17-20 and 24-27, both clefs), in For Children, Vol. II, p. 17.

__________, Piece No. 2 (Measures 5-8, both clefs), in For Children, Vol. I, p. 3.

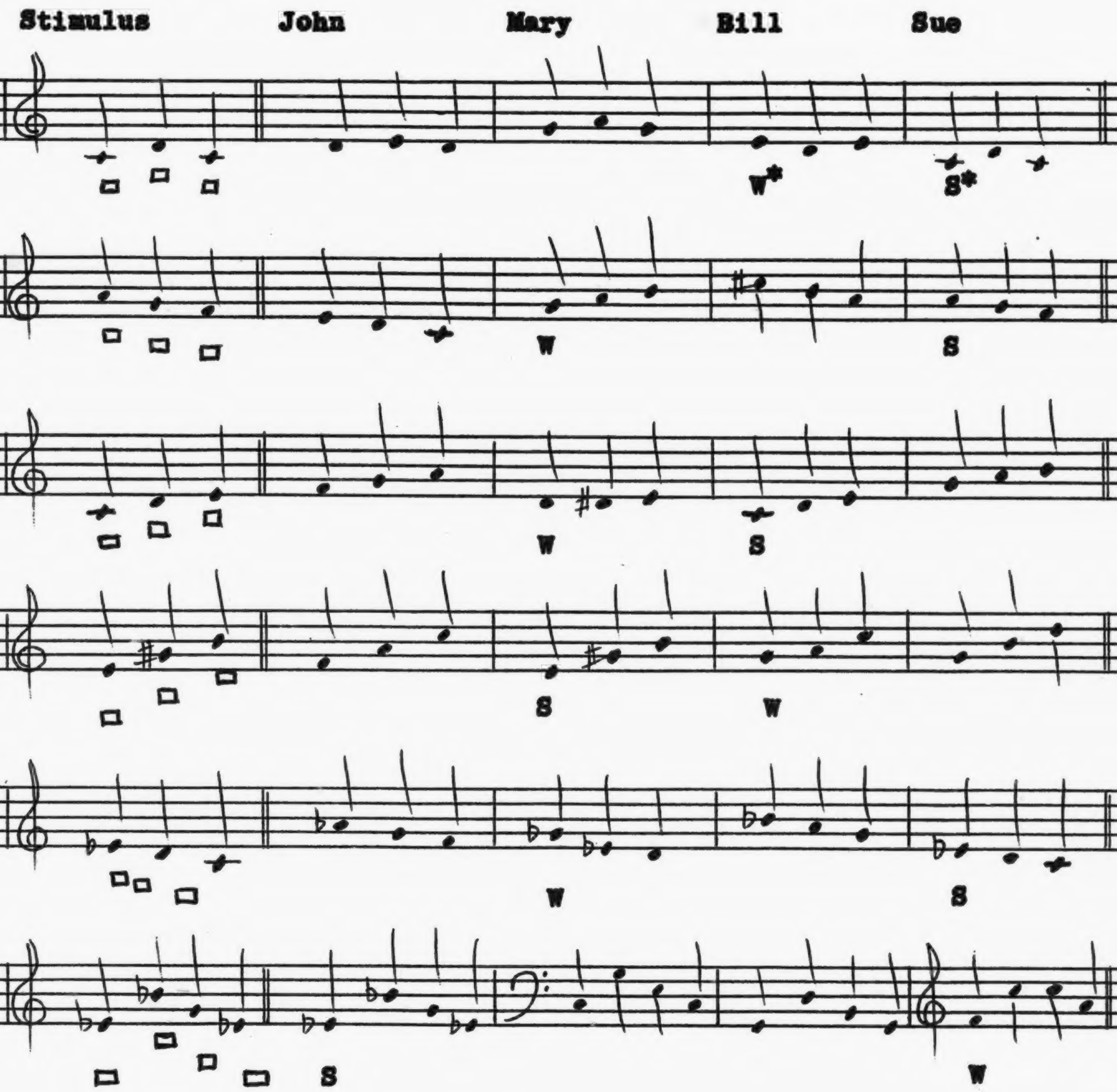
Task V. Conservation of Tonal Pattern.

This task is designed to study conservation of tonal patterns when they are transposed to different pitch levels. The task consisted of six examples of four items each. Again one item in each example was an exact replication of the stimulus. The position of items within each example was randomized. A visual stimulus was presented with each aural stimulus. The following story was the setting for the task.

> "Now we are going to hear the teacher teach John, Mary, Bill and Sue how to play some very short tunes on the piano. First the teacher will play the tune on the piano two times, like this,
>
> 
>
> to make sure that the children hear it and learn it. Then each of the children will have a chance to play it on the piano. But here is the trick. The children have to play the same song, but they can play it anywhere on the piano that they want, up higher than the teacher, or lower. But it has to be the same song. For instance, you know "Mary Had a Little Lamb," don't you? Well, if I sang it down here (Experimenter sings in very low register) and then sang it up high like this (sings it very high) it would still be the same song, wouldn't it? So, if the teacher plays this,
>
> 
>
> the child can play this
>
> 
>
> or this,
>
> 
>
> and they would be right, wouldn't they? What about this?
>
> 
>
> That would be wrong. So now you listen as the teacher plays the tune. You may sing with her and show with your hands whether the tones in the tune are moving up or down. Then listen to the children, and you be the judge. Tell me is the child is playing the tune right or wrong."

After each answer ask: "How does it sound the same?" or
"How does it sound right?"
"How does it sound different?" or
"How does it sound wrong?"
(depending on child's answer)

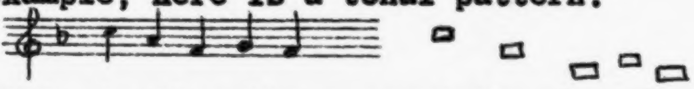
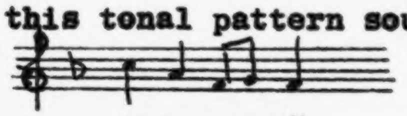
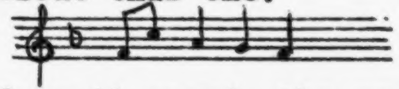
Task V


Stimulus
John
Mary
Bill
Sue
W*
S*
W
S
W
S
S
W
W
S
S
W

*W - Wrong ▭ - Visual
**S - Same as Stimulus

Task VI. Conservation of Tonal Pattern.

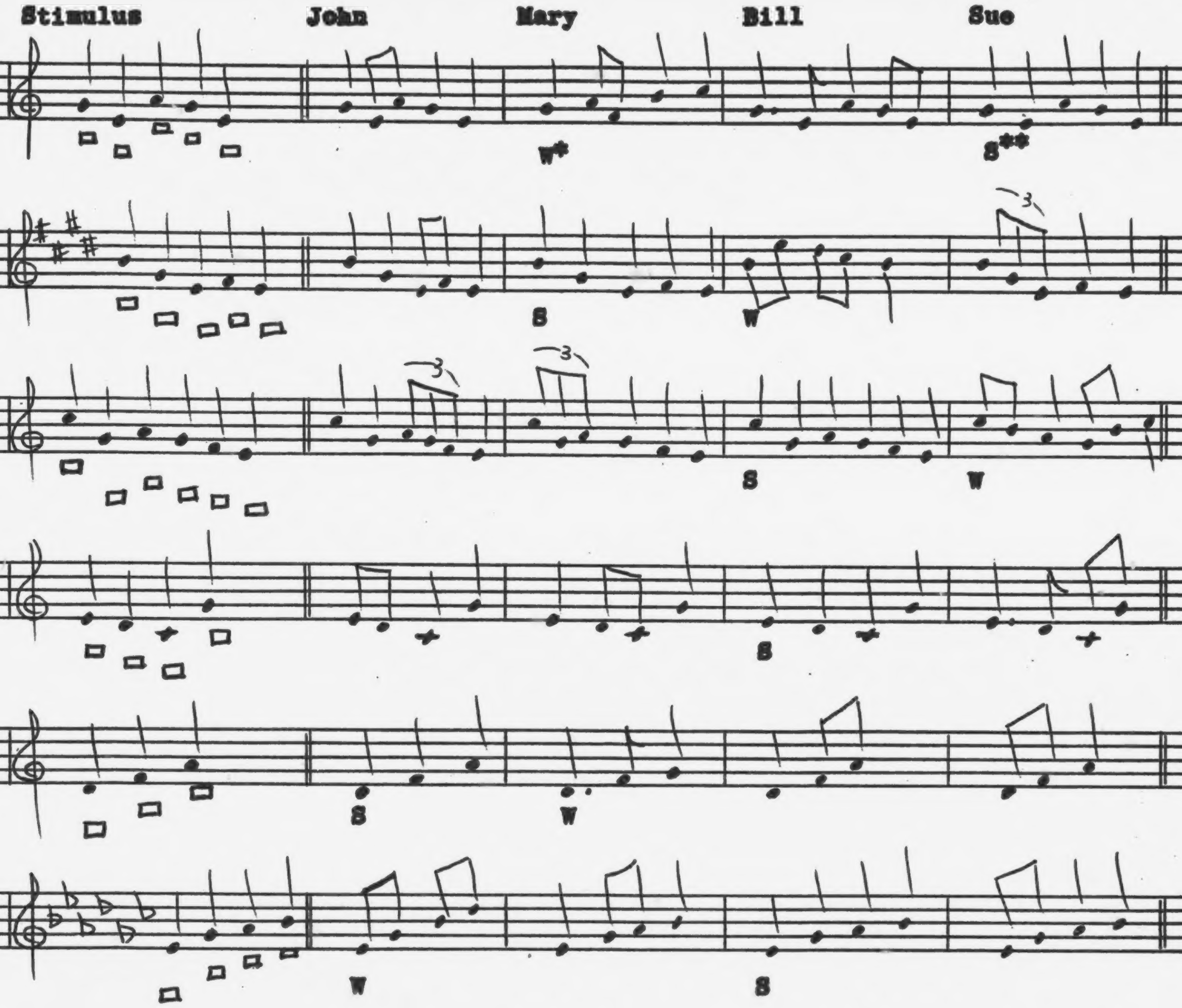
Task VI is the converse of Task III. In this task the tonal pattern is held constant while the rhythm patterns vary. It is designed to determine how much interference with pitch the subject can resist and still perceive the tonal pattern as the same. Task VI consisted of six examples of four items each. One item in each example was an exact replication of the stimulus. The position of items within each example was randomized. Both aural and visual stimuli were presented to the subjects. The story setting for Task VI was as follows:

> "Now we are going to hear the teacher teach the four children some little tunes on the piano. First the teacher will play the tune two times on the piano so that the children learn it and so that we can hear it too. You can sing the tonal pattern with the teacher and show with your hands whether the tones in the tune are moving up or down. Then each of the children will have a chance to play it on the piano. But here is a trick. The children have to play the same tune as the teacher but they can play any rhythm patterns that they want to play."
>
> "For example, here is a tonal pattern."
>
> 
>
> "Does this tonal pattern sound the same?"
>
> 
>
> "What about this one?"
>
> 
>
> ("How does it sound--the same or different," according to child's answer, was asked after each pattern.)

"Now some of the children might also make a mistake and play the wrong tonal pattern. You be the judge. After each child plays the tonal pattern on the piano, you tell me if he played it right, just like the teacher, or if he played it wrong."

After each answer ask:	"How does it sound the same?" or "How does it sound right?" "How does it sound different?" or "How does it sound wrong?" (depending on child's answer)

Task VI


Stimulus
John
Mary
Bill
Sue
W*
S**
S
W
3
3
3
S
W
S
S
W
W
S

*W - Wrong

**S - Same as Stimulus

▭ - Visual

SCORE CARD EXPERIMENT I

NAME: ____________________

AGE: ____________________

TEACHER: ____________________

RHYTHMIC

Task I

1.
2.
3.

Task II

1.
2.
3.
4.
5.
6.

Task III

	John	Mary	Bill	Sue
1.				
2.				
3.				
4.				
5.				
6.				

TONAL

Task IV

1.
2.
3.
4.
5.
6.

Task V

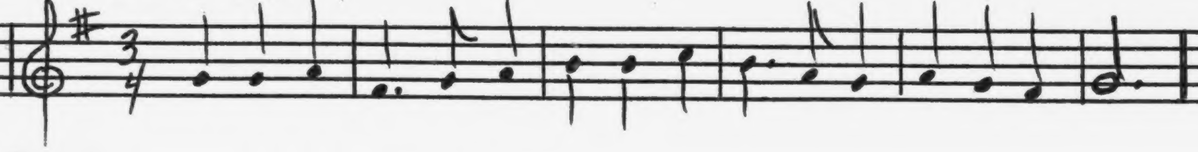
	John	Mary	Bill	Sue
1.				
2.				
3.				
4.				
5.				
6.				

Task VI

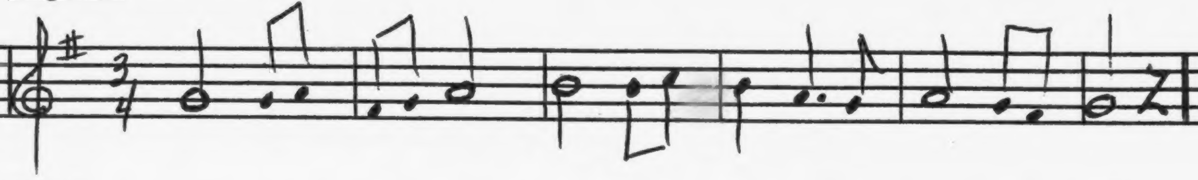
	John	Mary	Bill	Sue
1.				
2.				
3.				
4.				
5.				
6.				

APPENDIX C
EXPERIMENT II
Experimental Group Training Tape

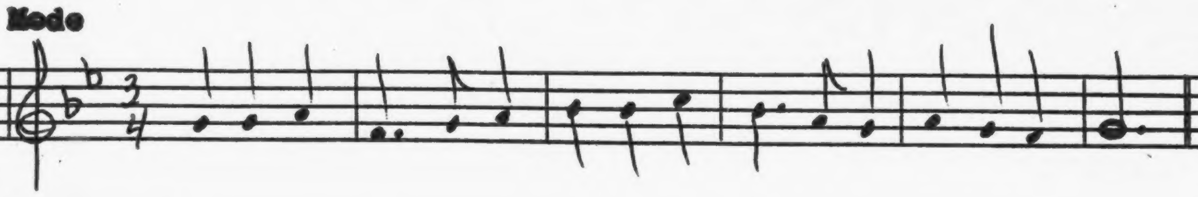
Standard ♩ = 96



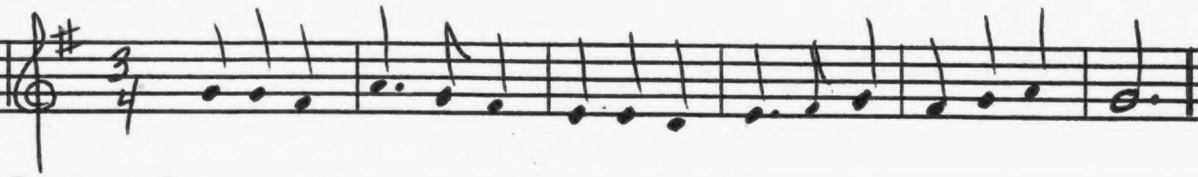
Rhythm



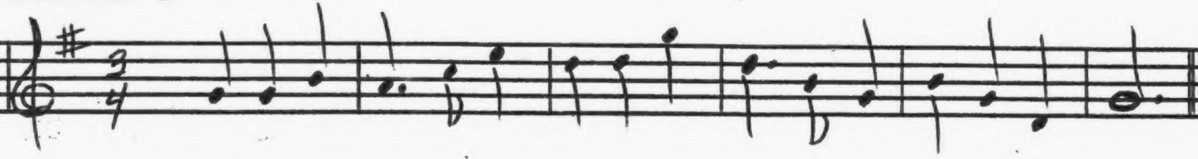
Mode



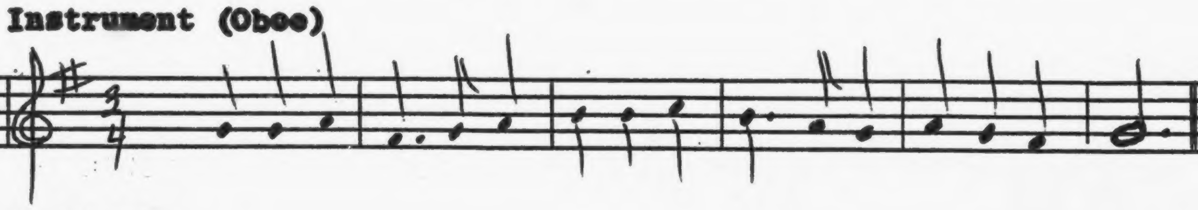
Conteur 1



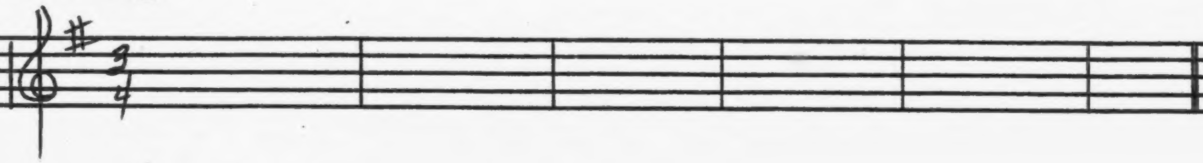
Conteur 2



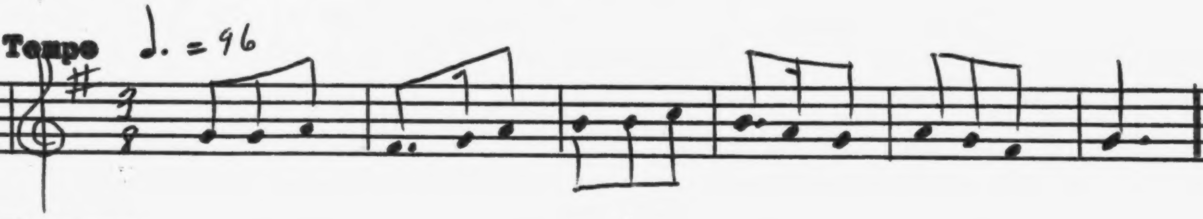
Instrument (Oboe)



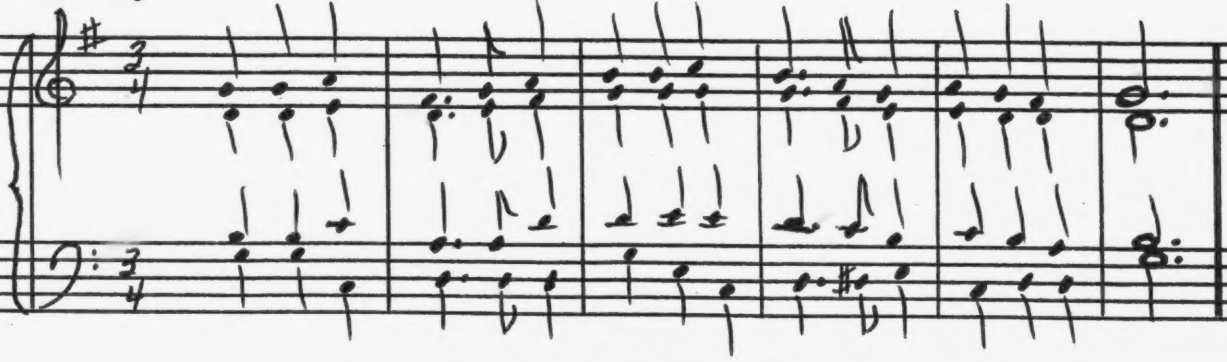
No Change



Tempo ♩. = 96

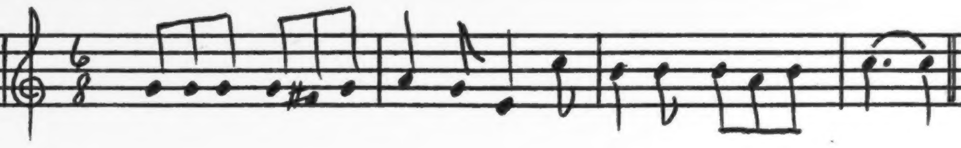


Harmony

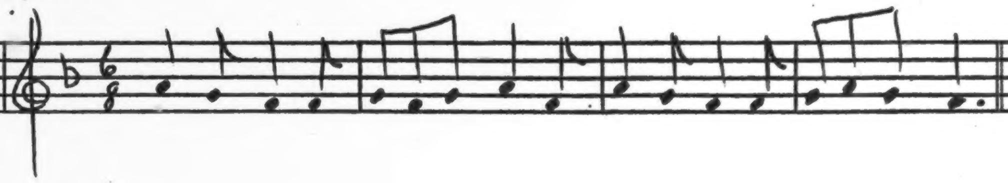


Control Group Training Tape

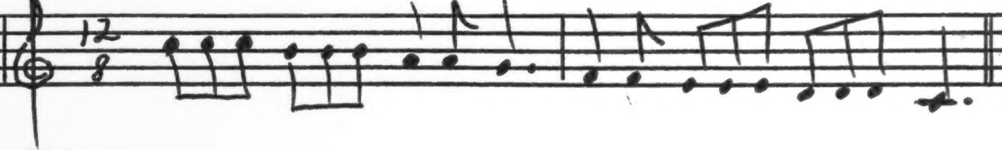
Fast



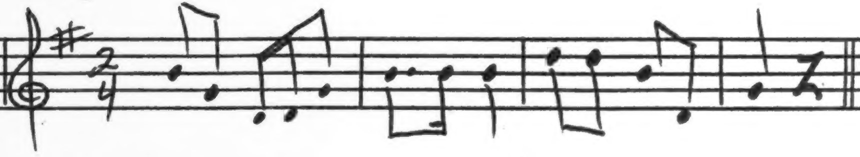
Slow



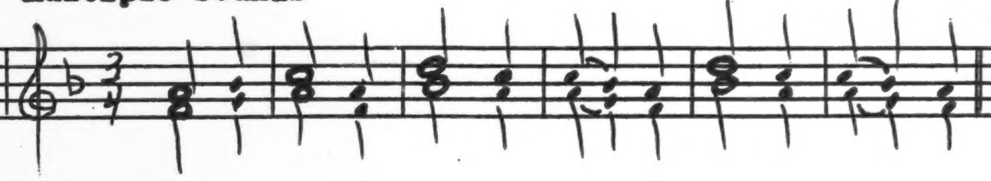
Stepwise



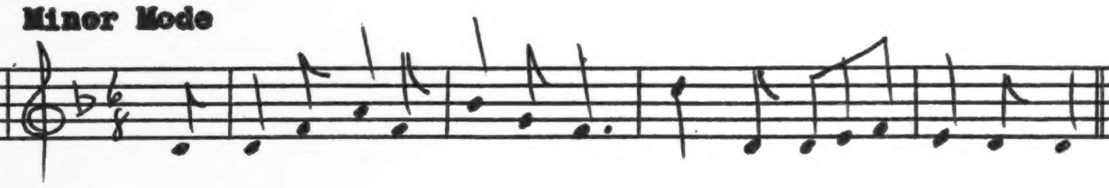
Skip



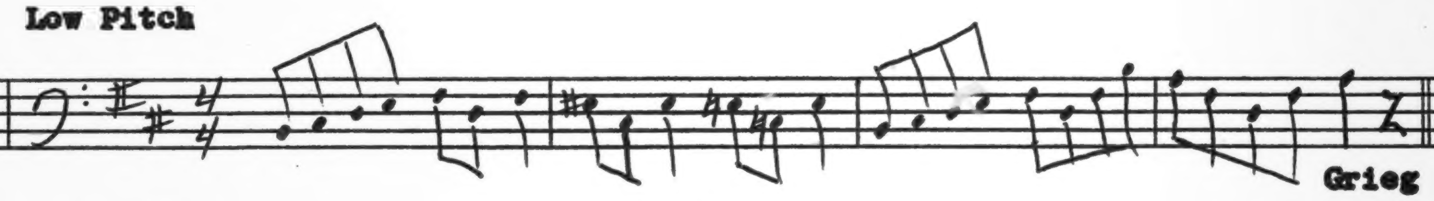
Multiple Sounds



Minor Mode

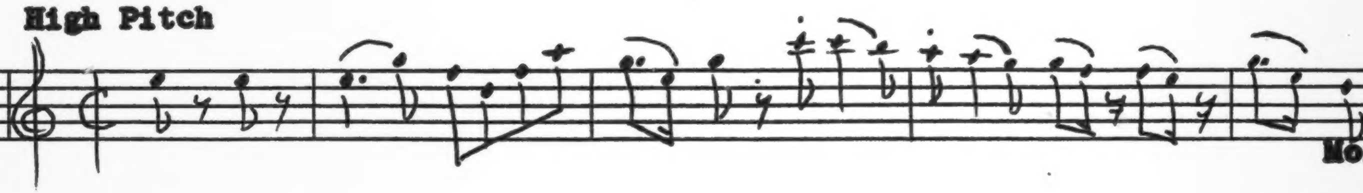


Low Pitch



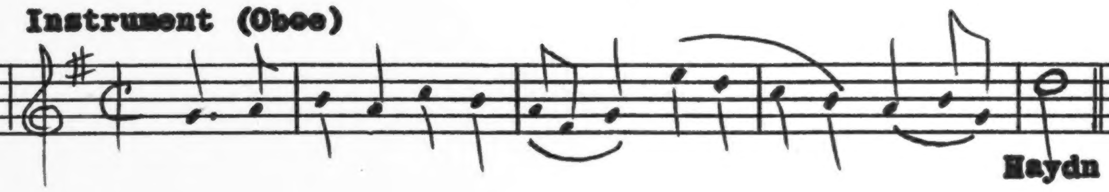
Grieg

High Pitch



Mozart

Instrument (Oboe)



Haydn

Tasks I-IV

The following copyrighted material has been removed:

Béla Bartók, Piece No.15 (Measures 1-4, treble clef), in For Children, Vol. I (Lynbrook, New York: Boosey and Hawkes, Inc.), p. 14.

__________, Piece No. 29 (Measures 9-12, bass clef), in For Children, Vol. I, p. 28.

__________, Piece No. 3 (Measures 1-4, treble clef), in For Children, Vol. II, p. 3.

__________, Piece No. 2 (Measures 5-8, treble clef), in For Children, Vol. I, p. 3.

EXPERIMENT II

ORDER OF TESTING TAPE STIMULI

TAPE ONE

Task I*	Task II*	Task III*	Task IV*
Rhythm	Mode	Harmony	Contour$_1$
Mode	Harmony	Contour$_2$	No Change
Contour$_1$	Instrument	No Change	Tempo
Contour$_2$	Tempo	Instrument	Rhythm
Instrument	Rhythm	Tempo	Contour$_2$
No Change	Contour$_2$	Contour$_1$	Instrument
Tempo	Contour$_1$	Mode	Harmony
Harmony	No Change	Rhythm	Mode

TAPE TWO

Task I*	Task II*	Task III*	Task IV*
Contour$_1$	Instrument	Contour$_2$	Mode
Instrument	Rhythm	Tempo	Harmony
Harmony	Contour$_2$	Rhythm	Contour$_1$
Mode	Tempo	No Change	No Change
Tempo	No Change	Mode	Instrument
Rhythm	Contour$_1$	Harmony	Contour$_2$
Contour$_2$	Harmony	Instrument	Rhythm
No Change	Mode	Contour$_1$	Tempo

*At the beginning of each task, the melody, or standard, for that task was played alone before the first item.

Score Cards were coded to correspond to Test Tapes.

ORDER OF TESTING TAPE STIMULI

TAPE THREE

Task I*	Task II*	Task III*	Task IV*
Instrument	Tempo	No Change	Contour$_1$
Contour$_1$	Instrument	Contour$_1$	Rhythm
Rhythm	No Change	Contour$_2$	Mode
Harmony	Contour$_2$	Mode	Harmony
Mode	Harmony	Harmony	Contour$_2$
Tempo	Mode	Rhythm	No Change
No Change	Rhythm	Tempo	Instrument
Contour$_2$	Contour$_1$	Instrument	Tempo

TAPE FOUR

Task I*	Task II*	Task III*	Task IV*
Harmony	No Change	Rhythm	Contour$_2$
Contour$_2$	Tempo	No Change	Mode
Mode	Instrument	Tempo	Harmony
Contour$_1$	Rhythm	Instrument	Contour$_1$
No Change	Contour$_1$	Contour$_1$	Rhythm
Instrument	Harmony	Mode	Tempo
Tempo	Mode	Contour$_2$	No Change
Rhythm	Contour$_2$	Harmony	Instrument

*At the beginning of each task, the melody, or standard, for that task was played alone before the first item.

APPENDIX D

EXPERIMENT III
Training Sessions

Instruction:	Seven days of instruction for experimental and control groups over a two-week period. Fifteen minute sessions for the kindergarten subjects; twenty minute sessions for second and fourth grade subjects. Three 45-minute sessions for experimental and control eighth grade subjects
Repertoire:	Experimental and control groups.

Kindergarten - Music for Young Americans. New York: American Book Company. 1959.

p. 84 - "The Bear Went Over the Mountain"

p. 113 - "The Goblin in the Dark"

Second Grade - Music for Young Americans. New York: American Book Company. 1959.

p. 40 - "Sandy"

p. 67 - "Halloween Fun"

Fourth Grade - Music for Young Americans. New York: American Book Company. 1960.

p. 20 - "By the Light of the Moon"

p. 52 - "Halloween"

"Are You Sleeping" with treatment with all grade levels in experimental group only.

"Are you Sleeping" sung as a round and with tone bells with both experimental and control groups.

EXPERIMENTAL GROUP

Kindergarten, Second, and Fourth Grades

Did you ever stop to imagine what it would be like to live in a world where everything looked the same, sounded the same, tasted the same, smelled the same, and felt the same? It wouldn't be a very exciting place to live, would it?

Or it wouldn't be much fun to wear the same skirt or trousers to school every day. But suppose I have a very favorite blue skirt and want to wear it often. One day I wear it with a white blouse, another day with a bright red sweater, and on a third day with a matching blue sweater. The skirt isstill the same blue skirt, but it looks different because I have worn different sweaters or blouses with it.

We all like to eat potatoes. But we may not want to eat baked potatoes every day. So we have French fries, American fries, potato chips, whipped potatoes, potato salad, potatoes au gratin and even potato soup. Just think of the many ways to cook potatoes. Remember we are still eating potatoes.

But let's talk about music. In music we can take pitches and make all sorts of changes or variations, as these changes are called, in the way we sing or play these pitches. Let's try one pitch. We can play it loud or soft, staccato or legato. Now we will try two, three, and four (etc.) pitches. (Demonstrate). But we can still hear that they are the same two (or more) pitches.

Now let's listen to the familiar song. "Are You Sleeping" and hear the kinds of changes that we can make. Throughout the song, in spite of the variations, we can hear that it is the same song. There is one place where you will hear a completely different kind of song. Can you find that place?

EXPERIMENTAL GROUP

Kindergarten, Second, and Fourth Grades

Tempo

Discuss in terms of walking. Walk slowly ......moderately...... faster.

Driving a car. Slow in city ...... fast on expressway. Is it still the same car?

Sing phrases of songs fast and slow.

Play tone bells C D E fast and slow. Then C D E F G fast and slow. Is it still the same tonal pattern?

Instrument

Sing song or songs. Play portions of song on piano, recorder, and tone bells. Is it still the same song?

Harmony

Sing song or songs. Add harmony on piano, on tone bells, on recorder, and on auto harp.

Have various students add a single note accompaniment on tone bell. Is it still the same song?

Transposition

Have students play "Hot Cross Buns" beginning on various pitch levels. Kindergarten children learn it by rote, beginning on C, F, and G. Second and fourth graders discuss in terms of pitch numbers. Is it still the same song?

Rhythm

Avoid words "fast" and "slow" in discussing rhythm. Discuss in terms of pattern within an interval of time.

A horse trots, canters, gallops. Suppose he travels a mile but with different patterns of movement within that mile. Is it still the same mile and the same horse?

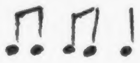
For example: You have one minute to say, "I like to hear music." Say it at the beginning of the minute ...... spaced throughout the minute ...... at the end of the minute.

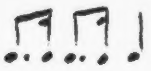
Picks up jacks in one minute. You might pick them up at the beginning of the minute ...... spaced throughout the minute ...... at the end of the minute.

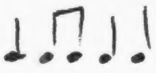
In the space of one (two) minutes play long and short patterns, on sticks and then on a single tone bell.

In the space of one (two) minutes play even and uneven rhythm patterns, on sticks and then on a single tone bell.

Have students "create" rhythm patterns. Discuss these patterns in terms of long, short, even, uneven.

Play  on G F E D C and C D E F G. Is it still the same rhythm pattern?

Play  on E F E D C and E F G D C. Is it still the same rhythm pattern?

Play  on C E G E C and G F E D C. Is it still the same rhythm pattern?

Discuss rhythm patterns in songs.

Mode

Kindergarten: Contrast "The Goblin in the Dark" (f minor) with "Farmer in the Dell" (F Major)

Second Grade: Change "Sandy" to key of e^b minor.

Fourth Grade: Change "By the Light of the Moon" to the key of g minor.

We have made a variation or change in the mode of the music. Musicians call this minor mode.

Have students experiment with tone bells: F G A B^b C, C D E F G,
A^b E^b

G A B C D, and D E F# G A
B^b F♮

Help fourth graders arrive at the principle involved.

Inversion

Tone bells C D E F G. Have students arrange by sound in ascending and decending order.

Tone bells C D E F G A B C. Have students arrange by sound in ascending and descending order. Use various combinations.

Tone bells G A B C D. Then turn upside down: D C B A G. G B D: G E C; G A C D: G F D C.

Have second and fourth graders especially experiment.

Use tune "Hot Cross Buns." Key of G.

	B A G	B A G	G G G G	A A A A	B A G
Invert:	B C D	B C D	D D D D	C C C C	B C D

Fourth graders sing the two parts of "Hot Cross Buns" as a further example of harmony.

Listen to inversion in "Are You Sleeping." This is a variation of the melody.

EXPERIMENTAL GROUP

Eighth Grade

First a discussion of "Are You Sleeping" variations.

Music in Our Times (Teacher's Edition). Morristown, New Jersey: Silver Burdett Company. 1960.

p. 88 - "An Mälzel," a two-part canon. Discuss melodic construction.

Listen: Beethoven. Second Movement of *Eighth Symphony*. Discuss Beethoven's use of "An Mälzel."

"Simple Gifts," a Shaker tune. Discuss melodic construction.

Listen: Copland. Variations on "Simple Gifts" from *Appalachian Spring*. Discuss variation techniques used.

Listen: Stravinsky. *A Greeting Prelude*. Discuss variation techniques used.

CONTROL GROUP

Kindergarten

p. 84 - Does this song move in 2's or 3's? Clap the rhythm of the meter. Then step this rhythm with the feet.

Clap the rhythm of the melody.

Play first phrase of song by ear. Give students tone bells F-B^b.

p. 113 - Does this song move in 2's or 3's? Clap rhythm of meter and rhythm of melody.

Play F G A^b on tone bells   Play last phrase by ear on tone bells.

Second Grade

p. 40 - Does this song move in 2's or 3's?

Find the rhythm patterns which represent short notes; longer notes.

Select a few students to play rhythm of meter on rhythm sticks.

Discuss melodic movement:
- (a) notes that stay the same
- (b) notes that move by step
- (c) notes that move by a skip. Identify skip as being a third.

Play phrases of song on tone bells.

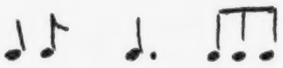
p. 67 - Does this song move in 2's or 3's? Discuss $\frac{2}{2}$ meter.

Discuss phrase structure and form.

Play g minor triad on tone bells.

Fourth Grade

p. 52 - Does this song move in 2's or 3's?

Discuss rhythm patterns in $\frac{6}{8}$ meter. 

Define melodic intervals.

p. 20 - Answer questions at top of page in song book.

Does the song move in 2's or 3's? Find the notes that move with the beat; faster than the beat; slower than the beat.

Play on piano and tone bells.

How many phrases are in the song? Does repetition or contrast predominate? What is the form of the song?

Eighth Grade

Music in Our Times (Teacher's Edition). Morristown, New Jersey; Silver Burdett Company. 1960.

p. 144 - "Gaudeamus Igitur" in three parts.

p. 145 - "I Pledge Myself Faithful" in two parts.

Watch notation for second and third themes from Brahms *Academic Festival Overture* as piano plays.

Listen: Brahms. *Academic Festival Overture*.

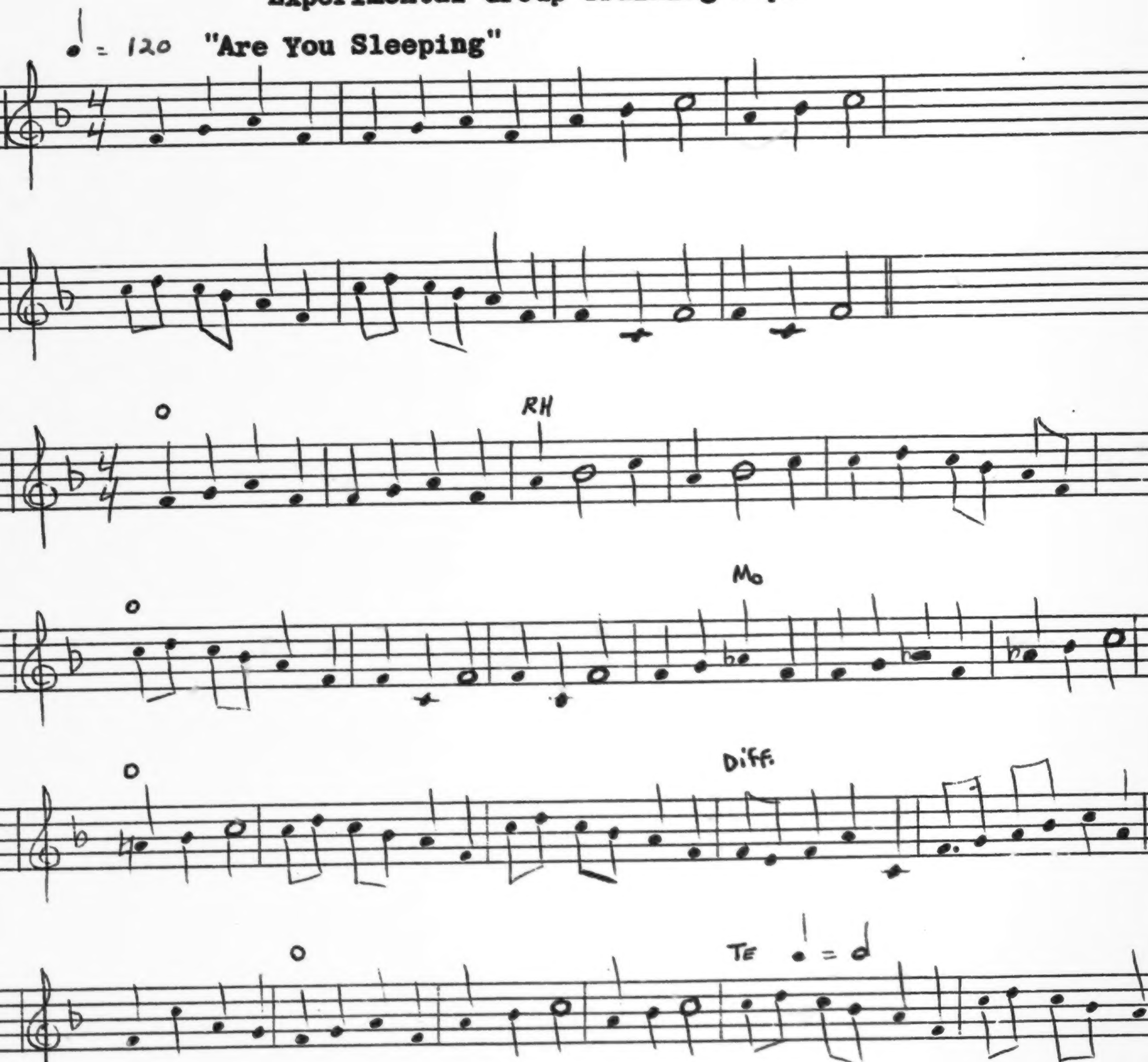
p. 131 - "Aura Lee." Discuss chords. Have students play chords on guitar.

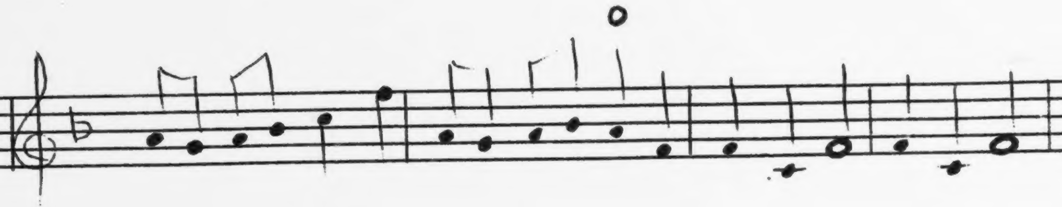
p. 4 - "Shenandoah." Work out bell accompaniment.

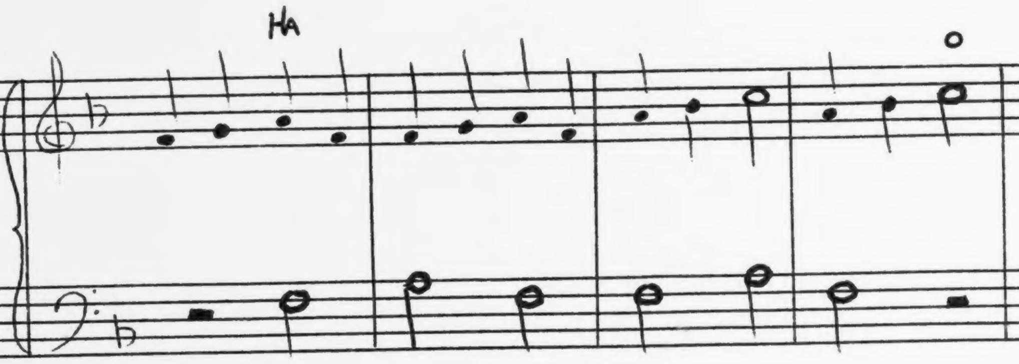
APPENDIX E

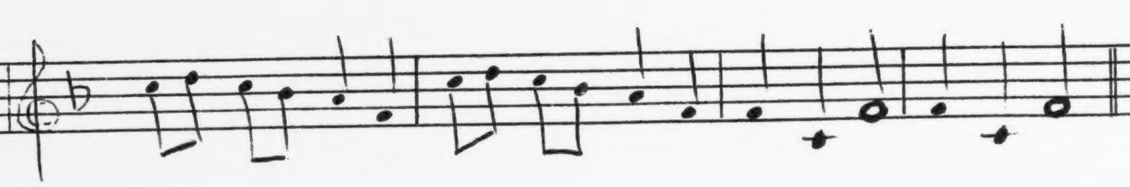
EXPERIMENT III

Experimental Group Training Tape


♩ = 120
"Are You Sleeping"
RH
Mo
Diff.
Te ♩ = 𝅗𝅥
𝅗𝅥 = ♩
Inst.
Trans.
Co







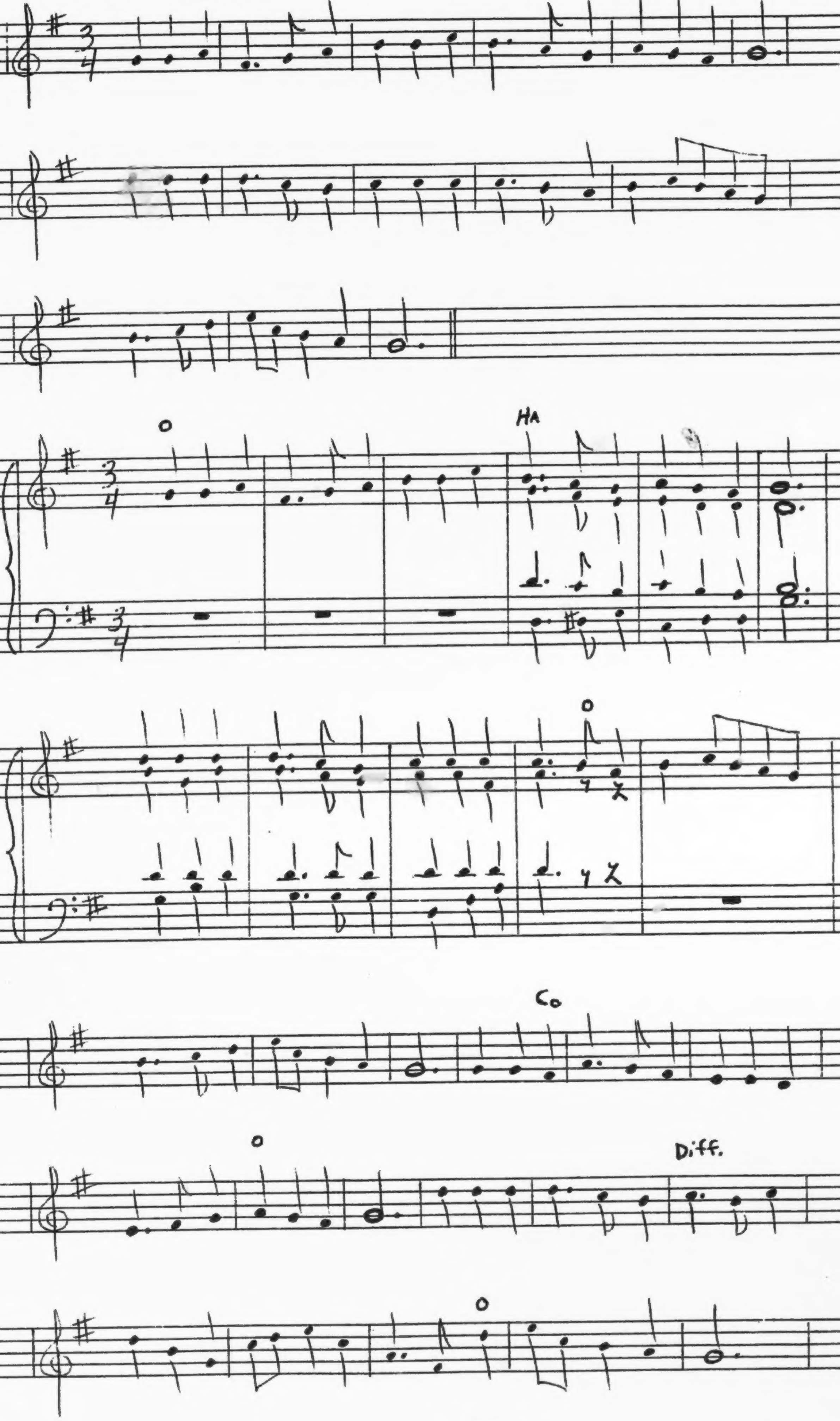
O - Original
Rh - Rhythm
Mo - Mode

Trans - Transposition
Co - Contour (Inversion)
Ha - Harmony

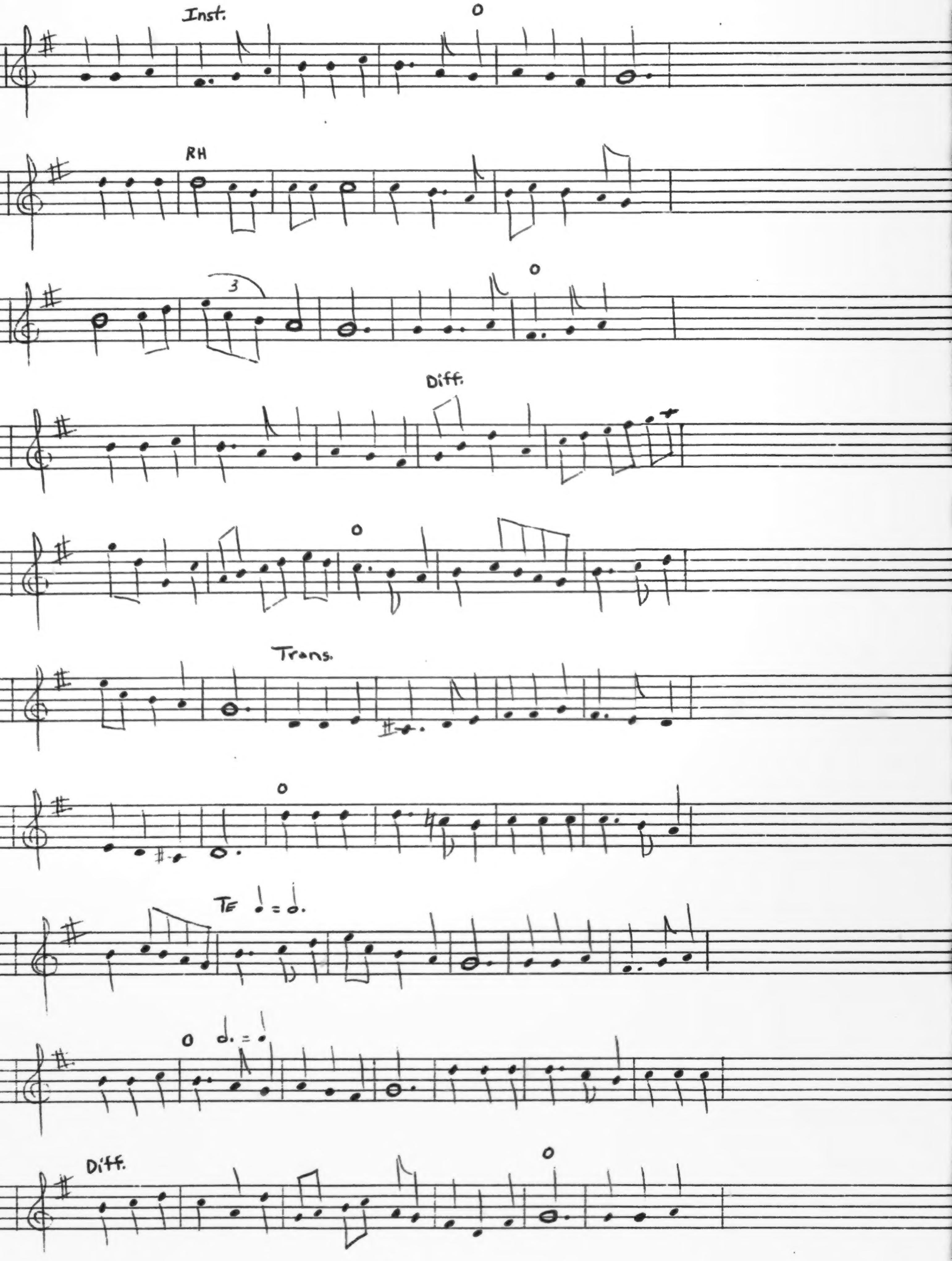
Diff - Different
Te - Tempo
Inst - Instrument

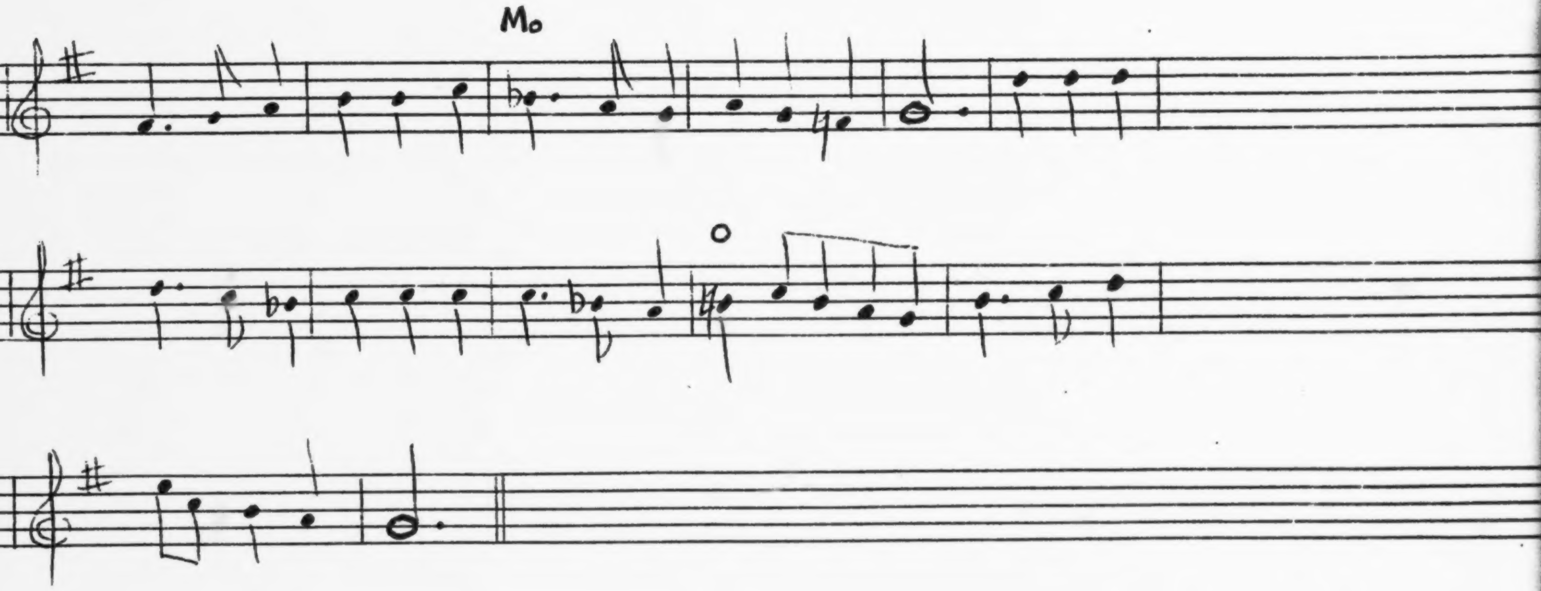
Task I

♩ = 100 "America"



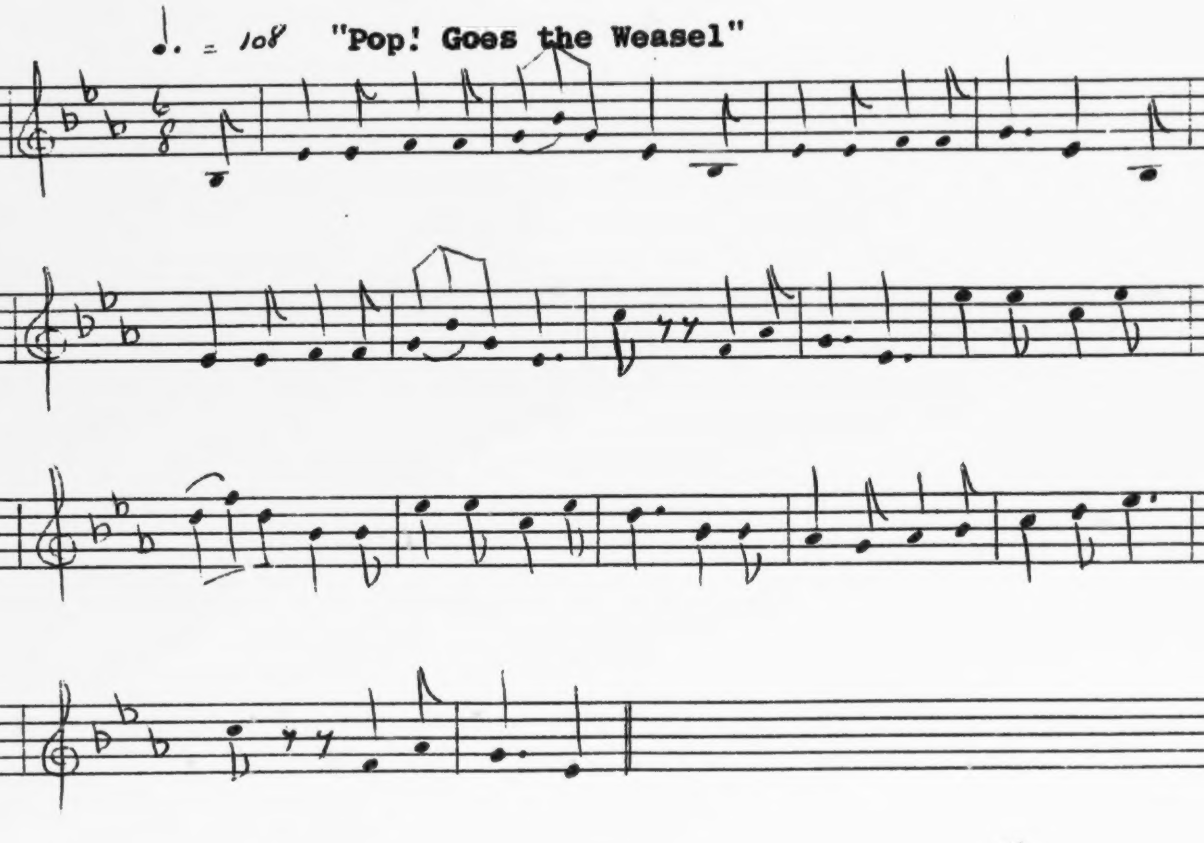
o
HA
o
Co
o
Diff.
o

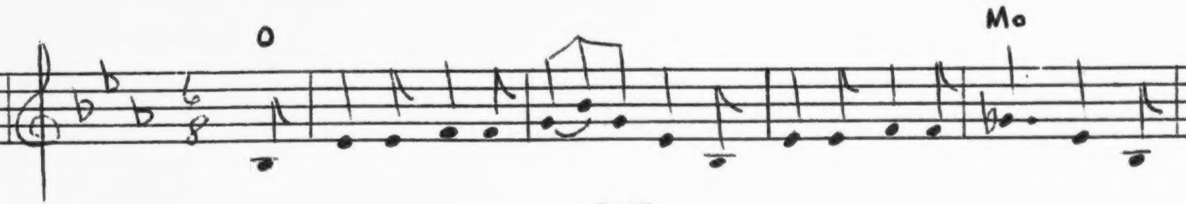

Inst.
o
RH
3
o
Diff.
o
Trans.
o
TE
o
Diff.
o

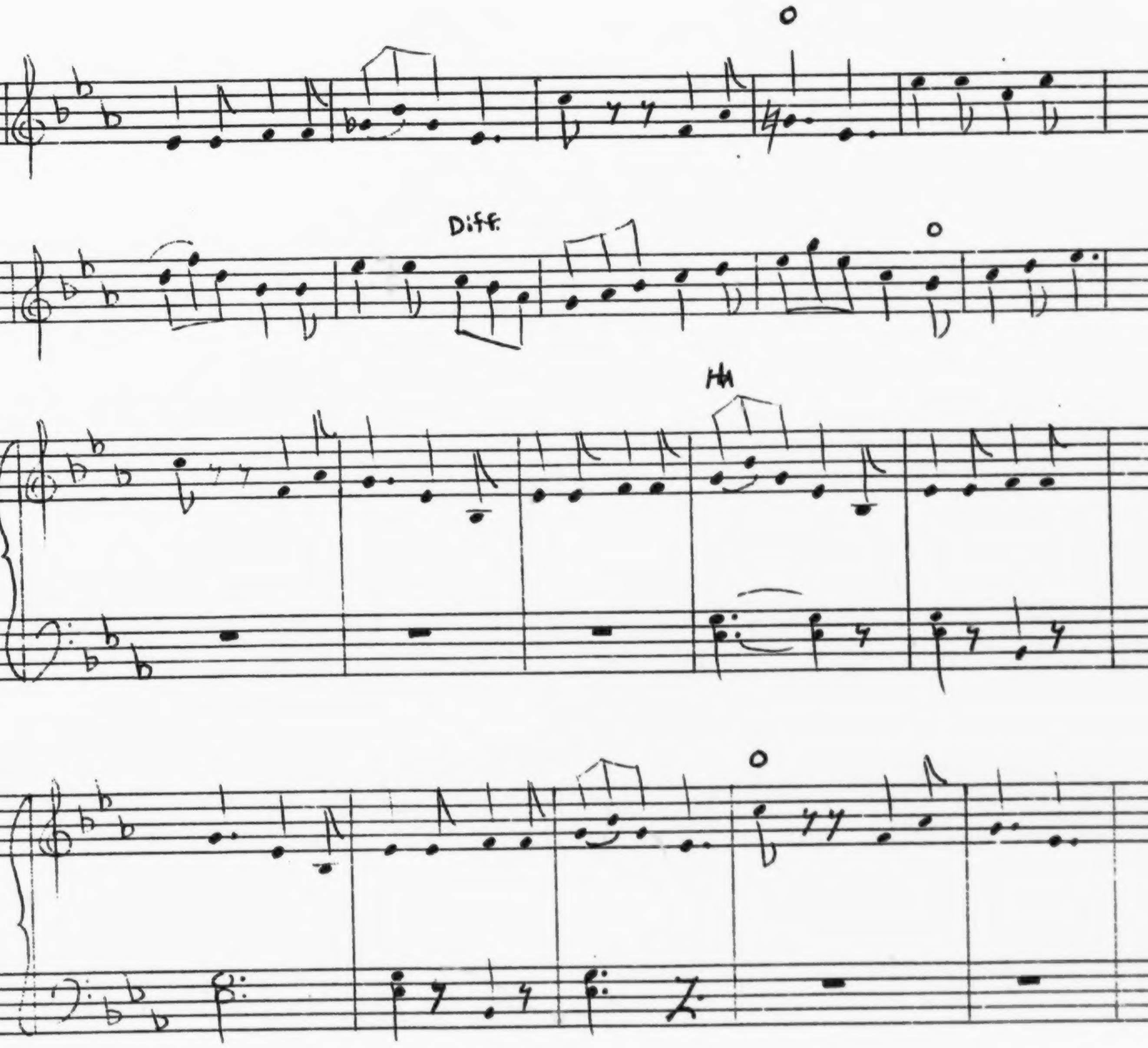


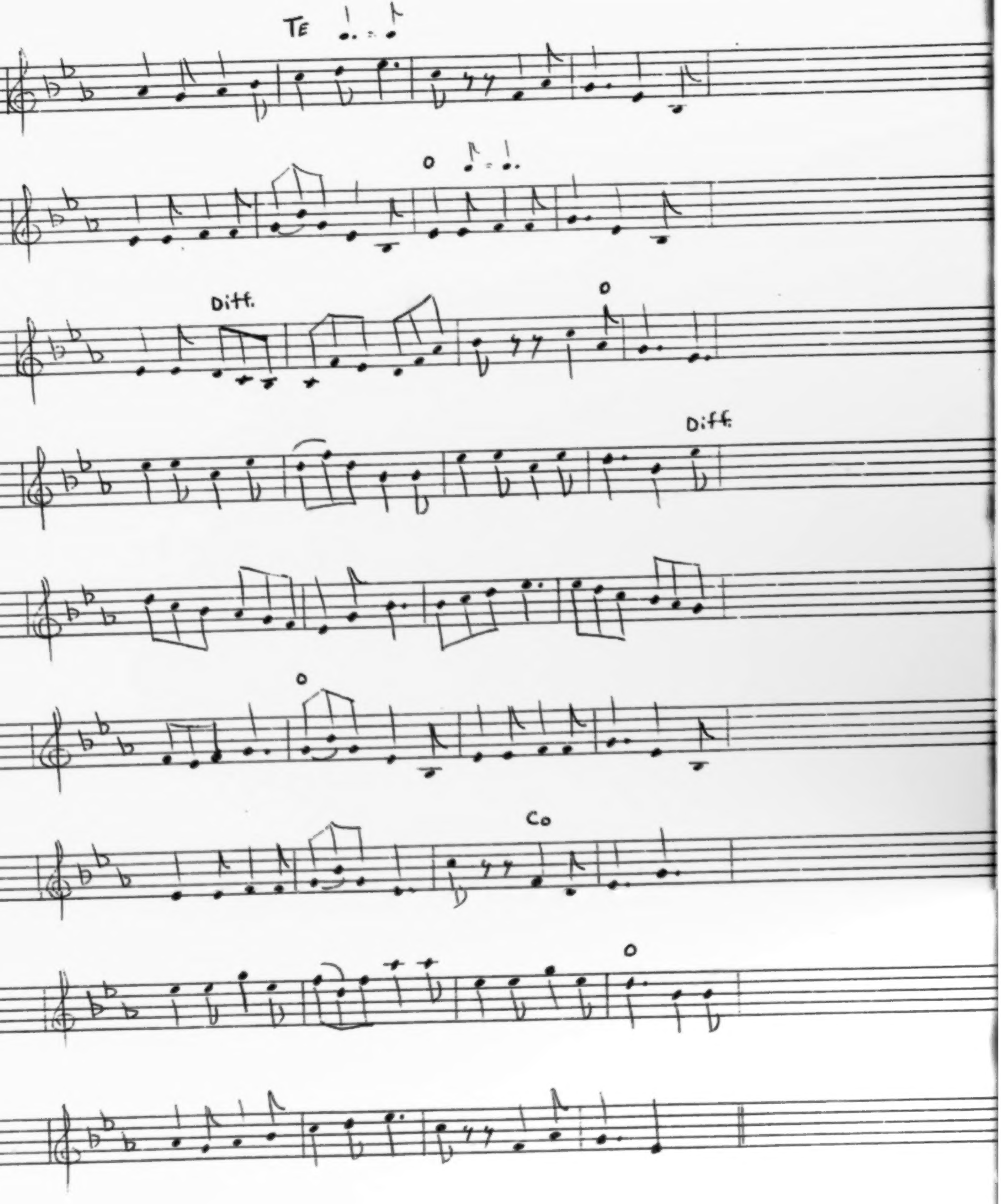
Task II

"Pop! Goes the Weasel"



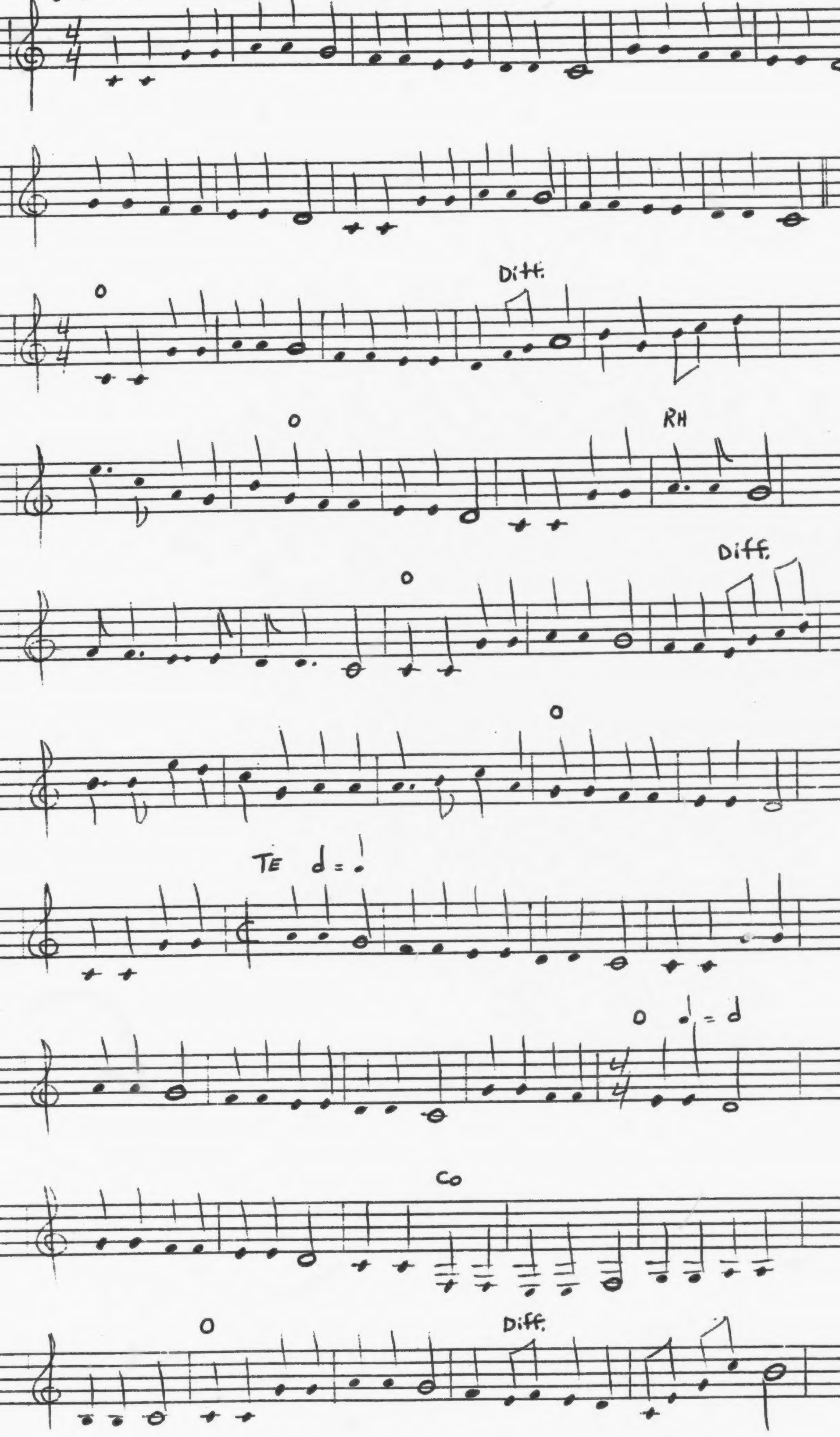


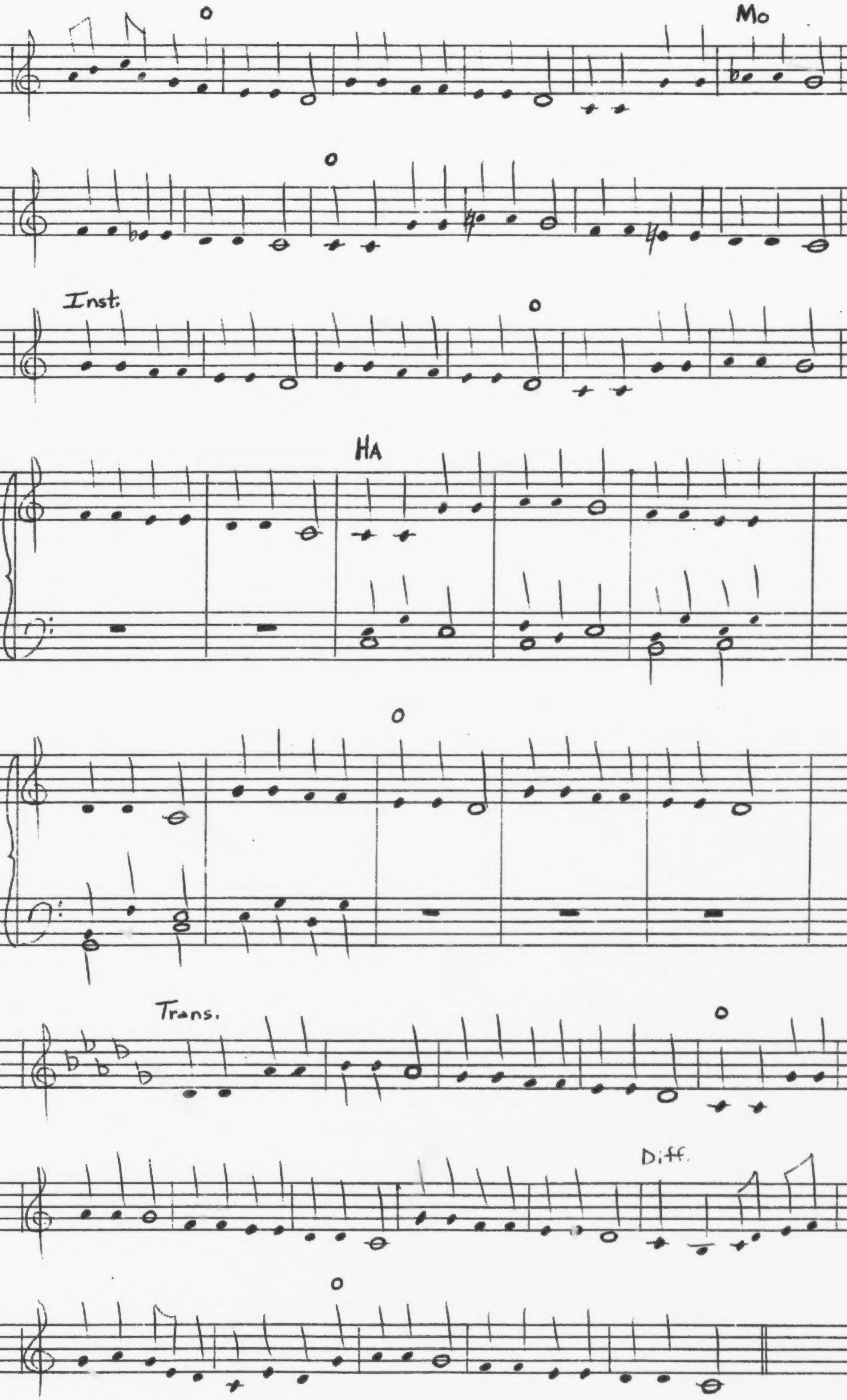

o
Diff.
o
HA
o
Trans.
o
RH
o
Inst.
o


TE
O
Diff.
O
Diff.
O
Co
O

Task III

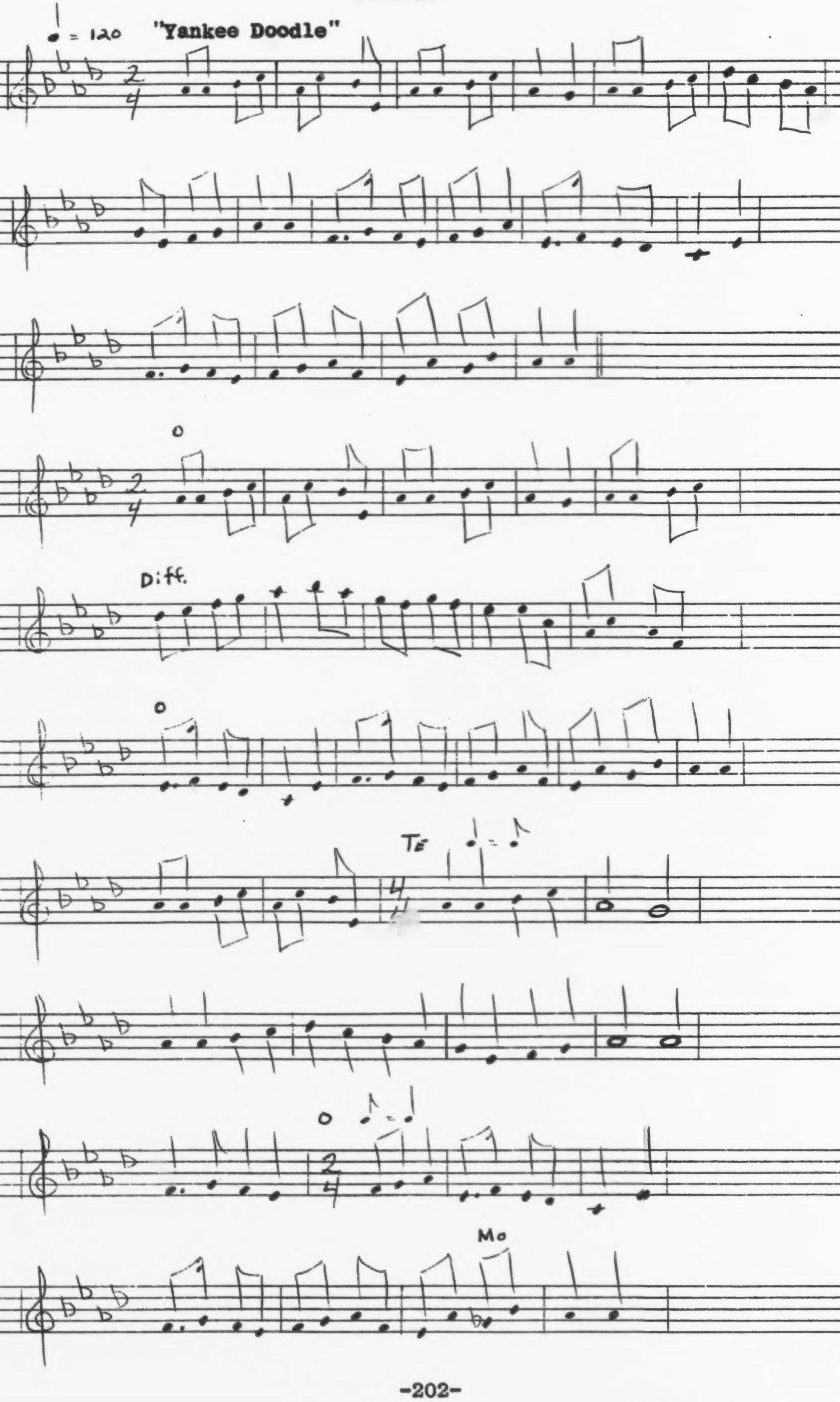
♩ = 120 "Twinkle, Twinkle Little Star"

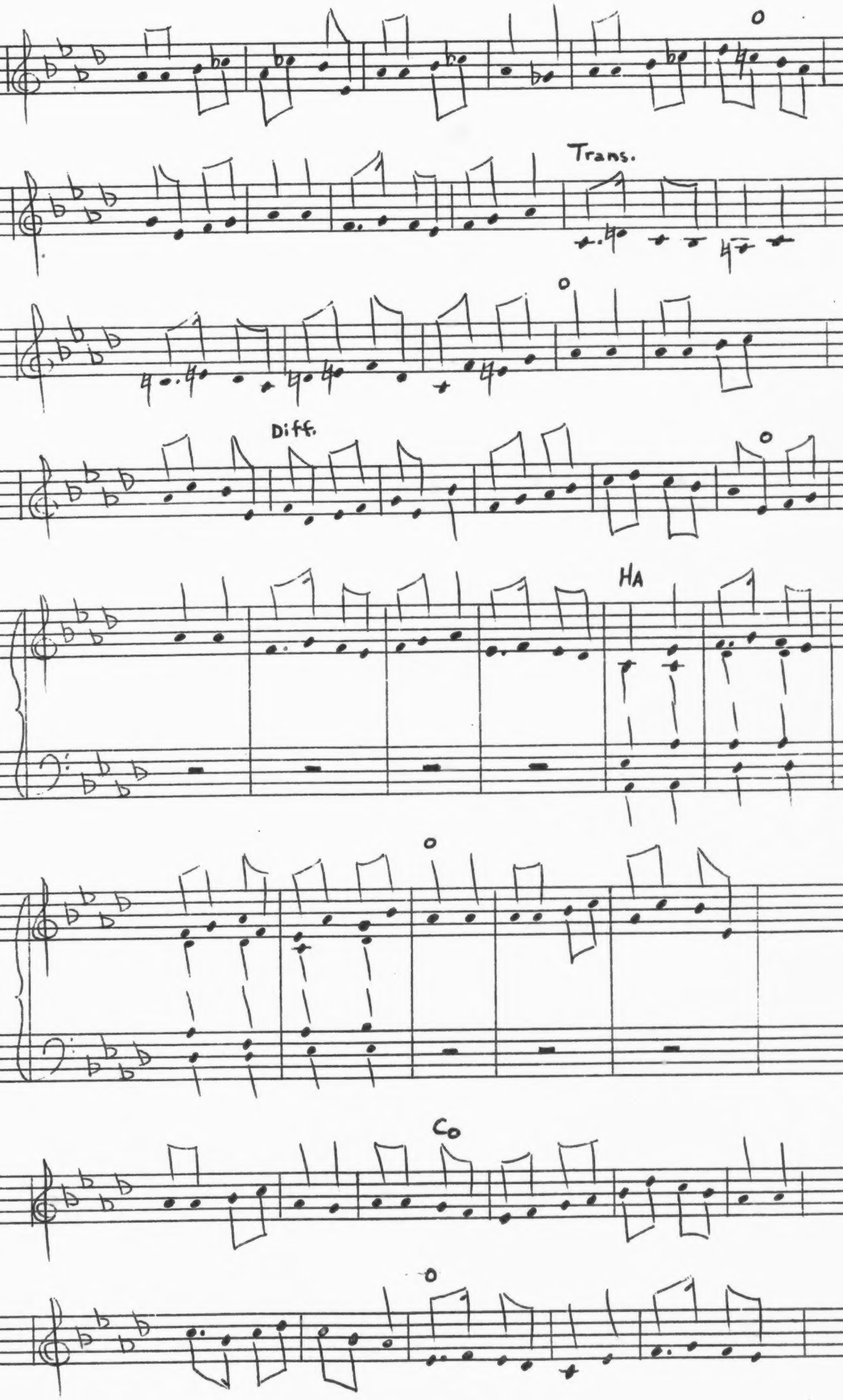

O
Diff.
O
RH
O
Diff.
O
TE 𝅗𝅥 = ♩
O ♩ = 𝅗𝅥
CO
O
Diff.

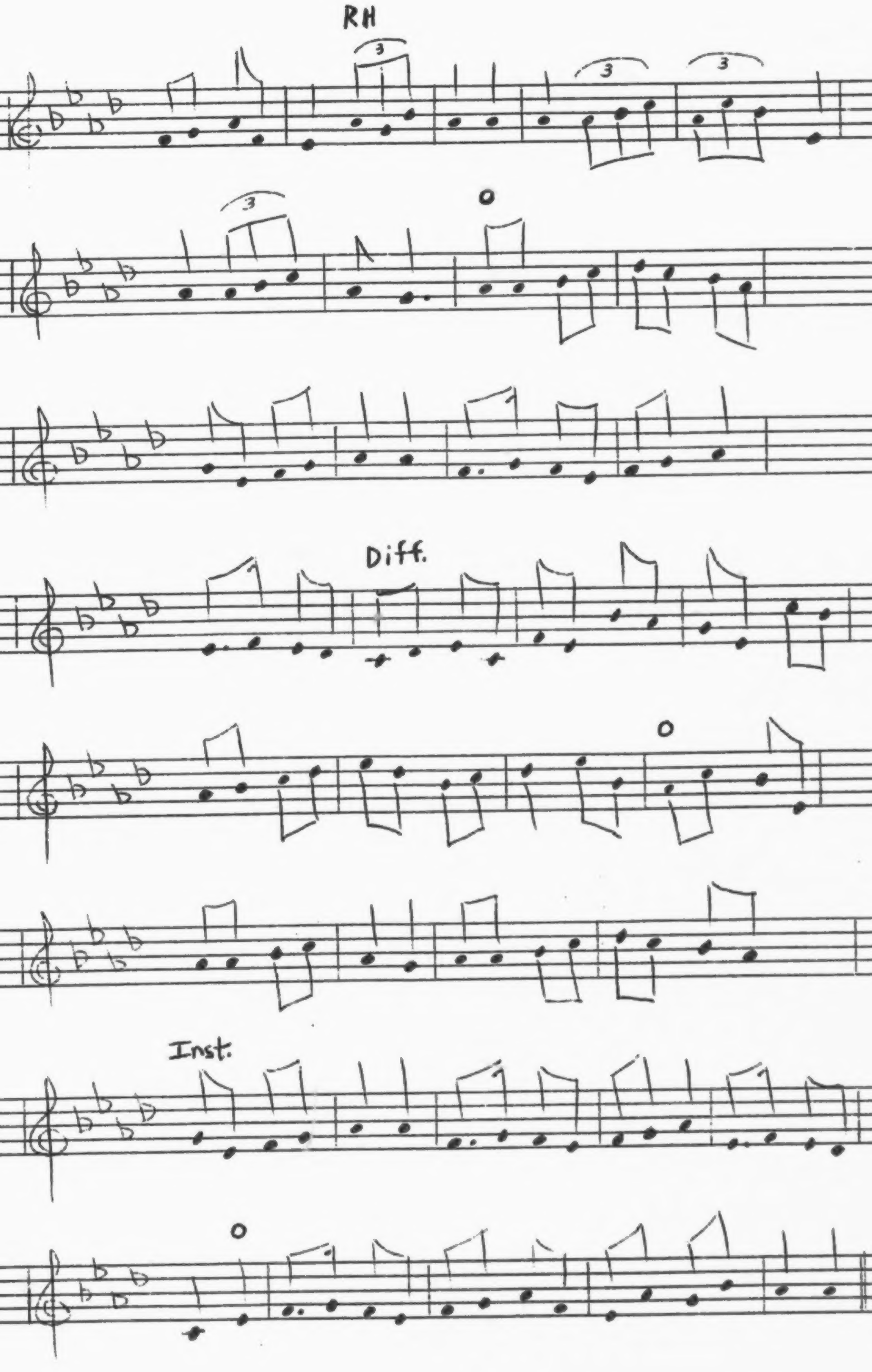

o
Mo
o
Inst.
o
HA
o
Trans.
o
Diff.
o

Task IV

"Yankee Doodle"


♩ = 120
2/4
o
Diff.
o
TE
♩. = ♪
4/4
o
♪. = ♩
2/4
Mo


o
Trans.
o
Diff.
o
HA
o
Co
o


RH
3
3
3
3
o
Diff.
o
Inst.
o

APPENDIX F

EXPERIMENT IV
Training Session

Do you know this familiar song?

That's right. It is "Are You Sleeping."

We can change or vary the song in different ways, but we can still hear that it is the same song.

Let's listen to some changes in the song "Are You Sleeping." Hear how a part of the regular or unchanged song comes between each change.

Listen to this change in long notes and short notes. (Return to original)

Now we hear a minor key. (Return)

Listen to this completely different song. (Return)

Now it is played much faster. (Return)

Here the violin plays the song. (Return)

Now we hear the song "Are You Sleeping" turned upside down. (Return)

Listen to the harmony part. (Return)

Now we will change two things at the same time.

The long notes and short notes are changed and it is also played much faster. (Return)

Now hear the violin with a harmony part on the piano.

....

Now let's listen to the entire song. Can you hear the changes in the song? Can you find the completely different song?

....

Then proceed to the instructions for either Condition I or Condition II.

Condition I

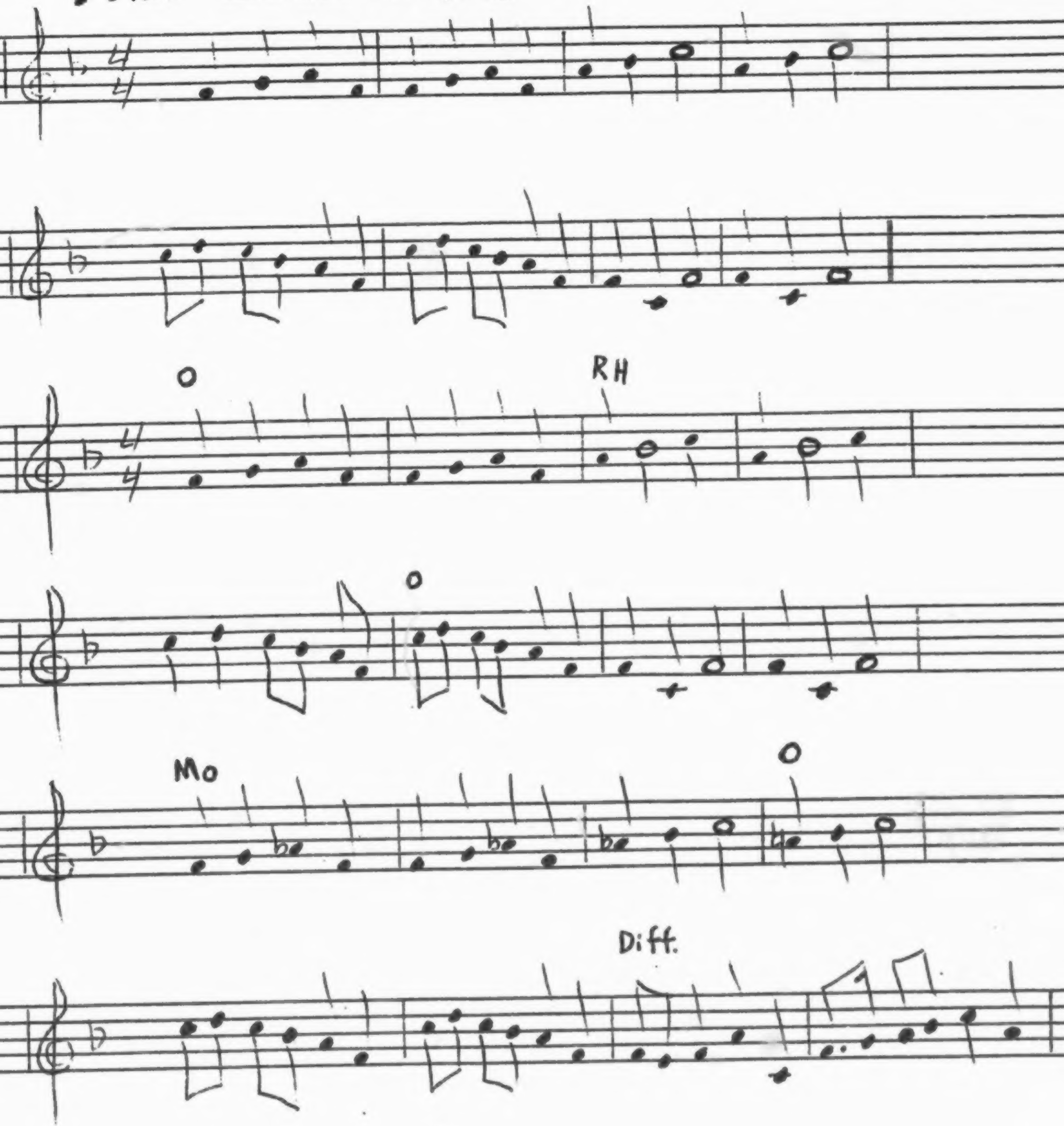
Now we will listen to "Are You Sleeping" again. When you hear the song played a little differently, but you can still tell that it is the same song, push the black key and hold it down during the whole time the song is a little different. Whenever you hear a completely different song, push the white key and hold it down during the whole time the song is completely different. If the song sounds exactly the same without any changes at all, do not push any key. I will help you this time and tell you if you are right or wrong when you push the keys.

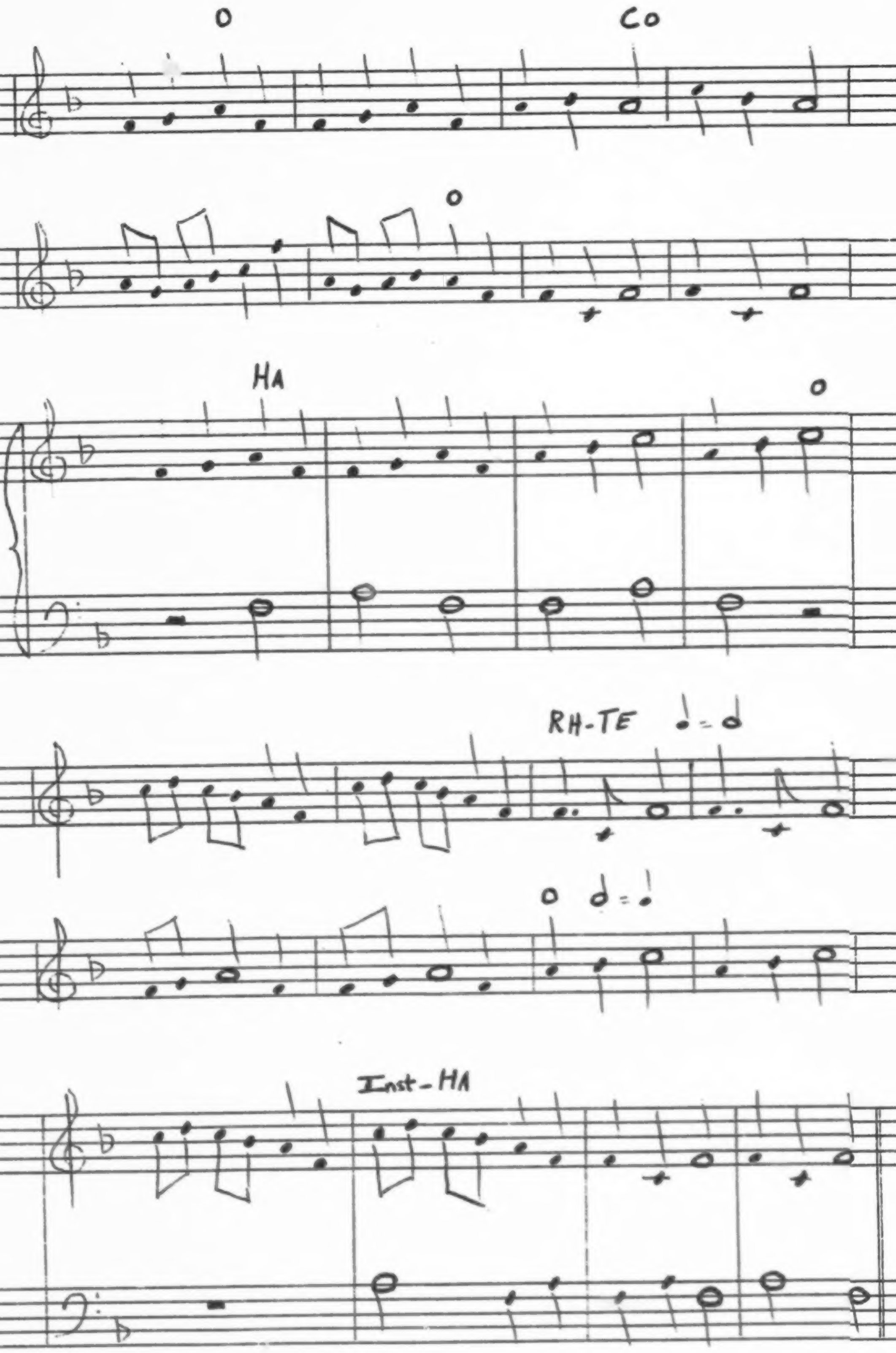
Condition II

Now we will listen to "Are You Sleeping" again. When you hear a completely different song, push the black key and hold it down during the whole time the song is completely different. Whenever you hear the same song, although it might be changed a little bit, do not push any key. I will help you this time and tell you if you are right or wrong when you push the key.

EXPERIMENT IV
Training Tape

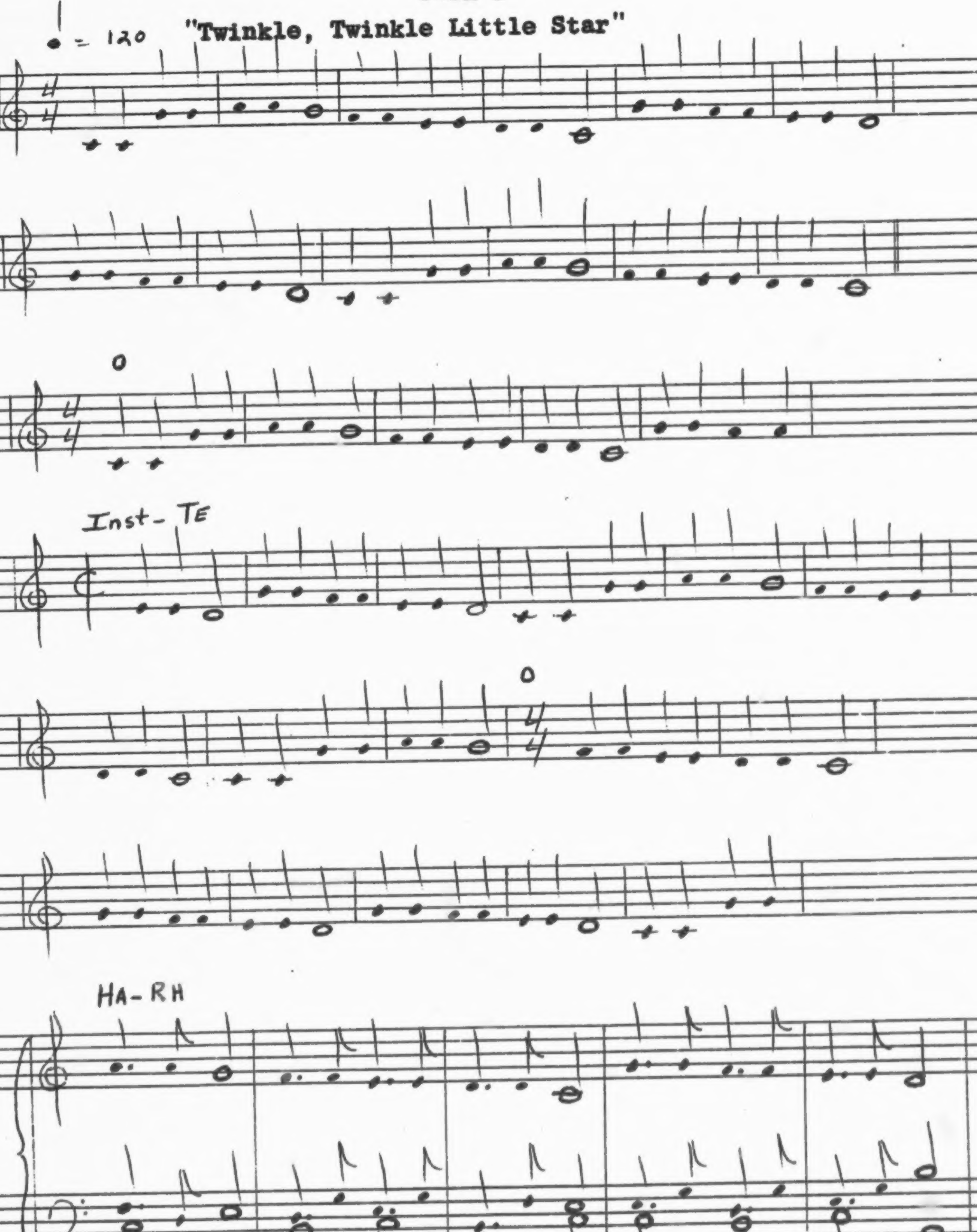
♩ = 120 "Are You Sleeping"

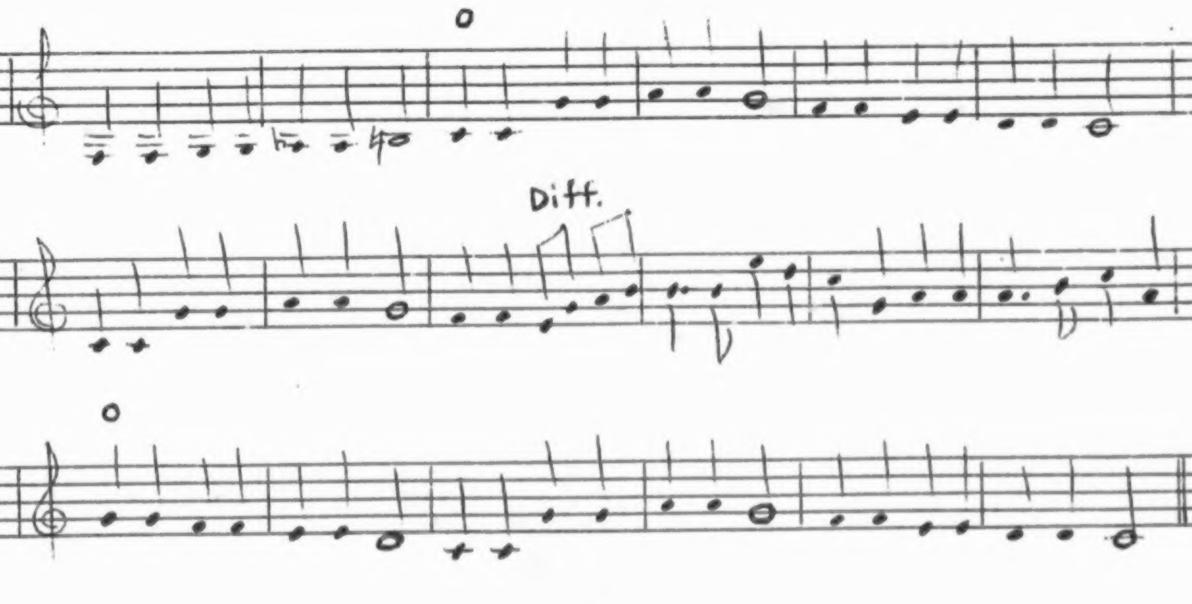

O
RH
O
Mo
O
Diff.
O
TE ♩. = ♩
O ♩ = ♩.
Inst.


O
CO
O
HA
O
RH-TE
O
Inst-HA

Task I

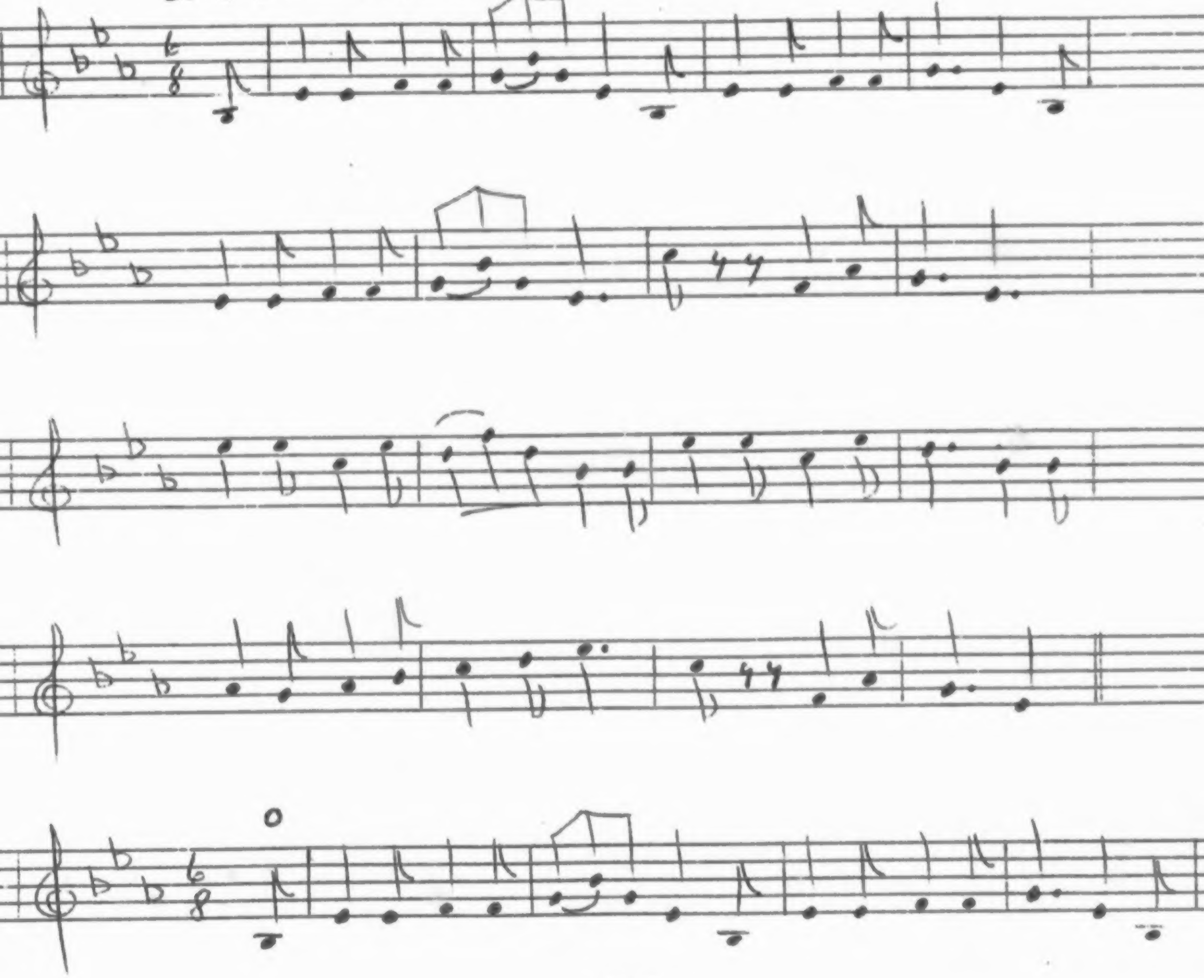
"Twinkle, Twinkle Little Star"

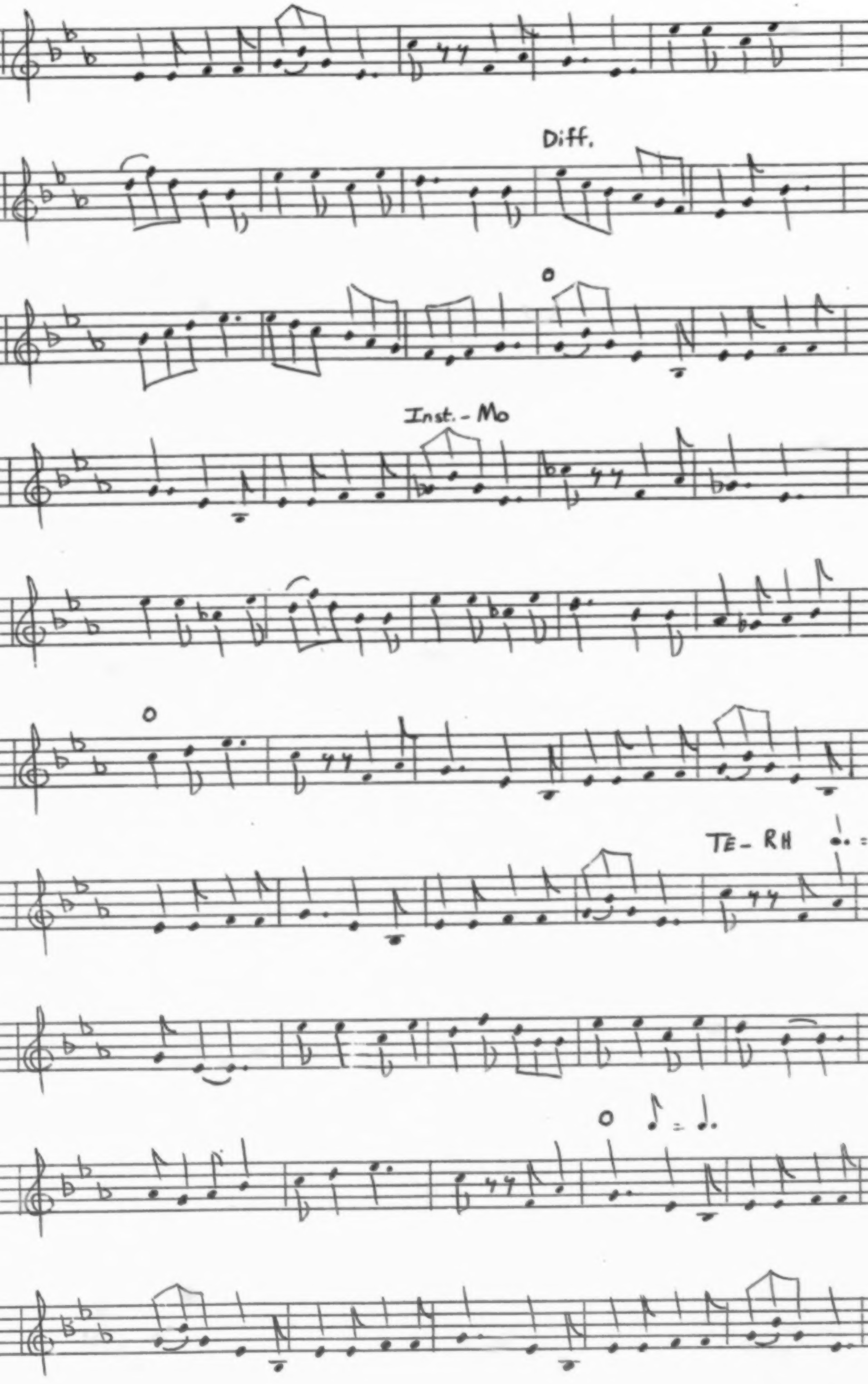

♩= 120
o
Inst-TE
o
HA-RH
o
Mo-Co

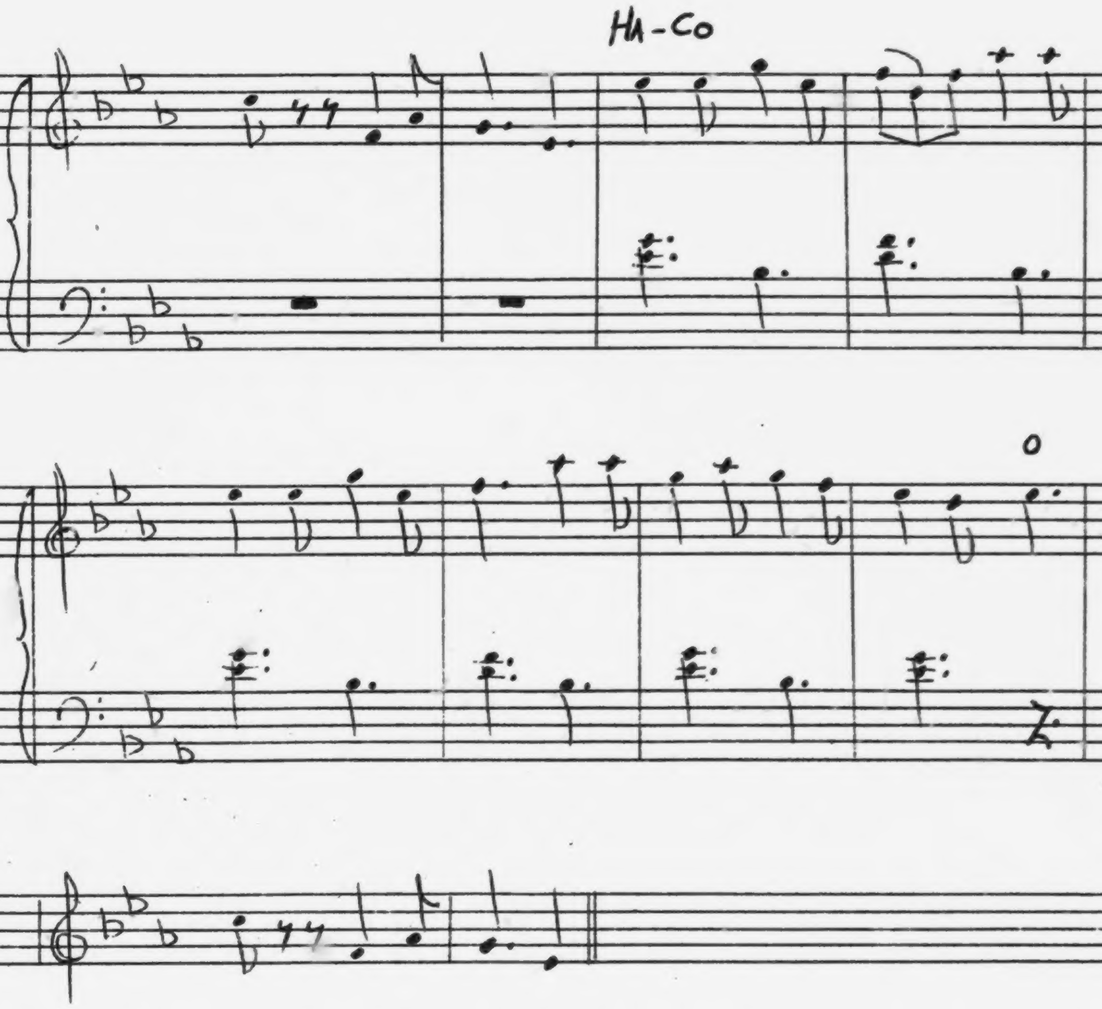


Task II

♩. = 108 **"Pop! Goes the Weasel"**

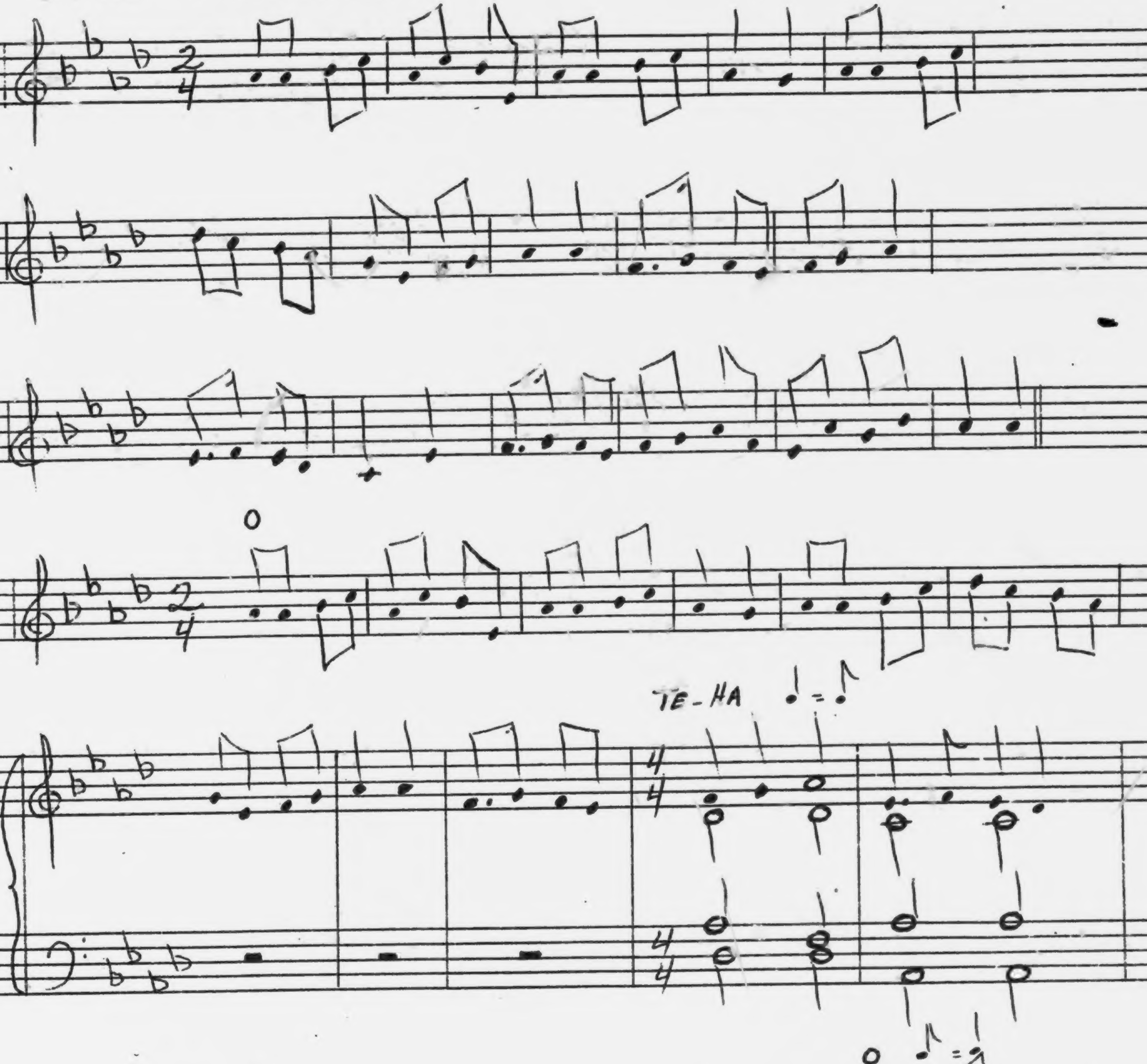



Diff.
o
Inst. - Mo
o
TE- RH
o

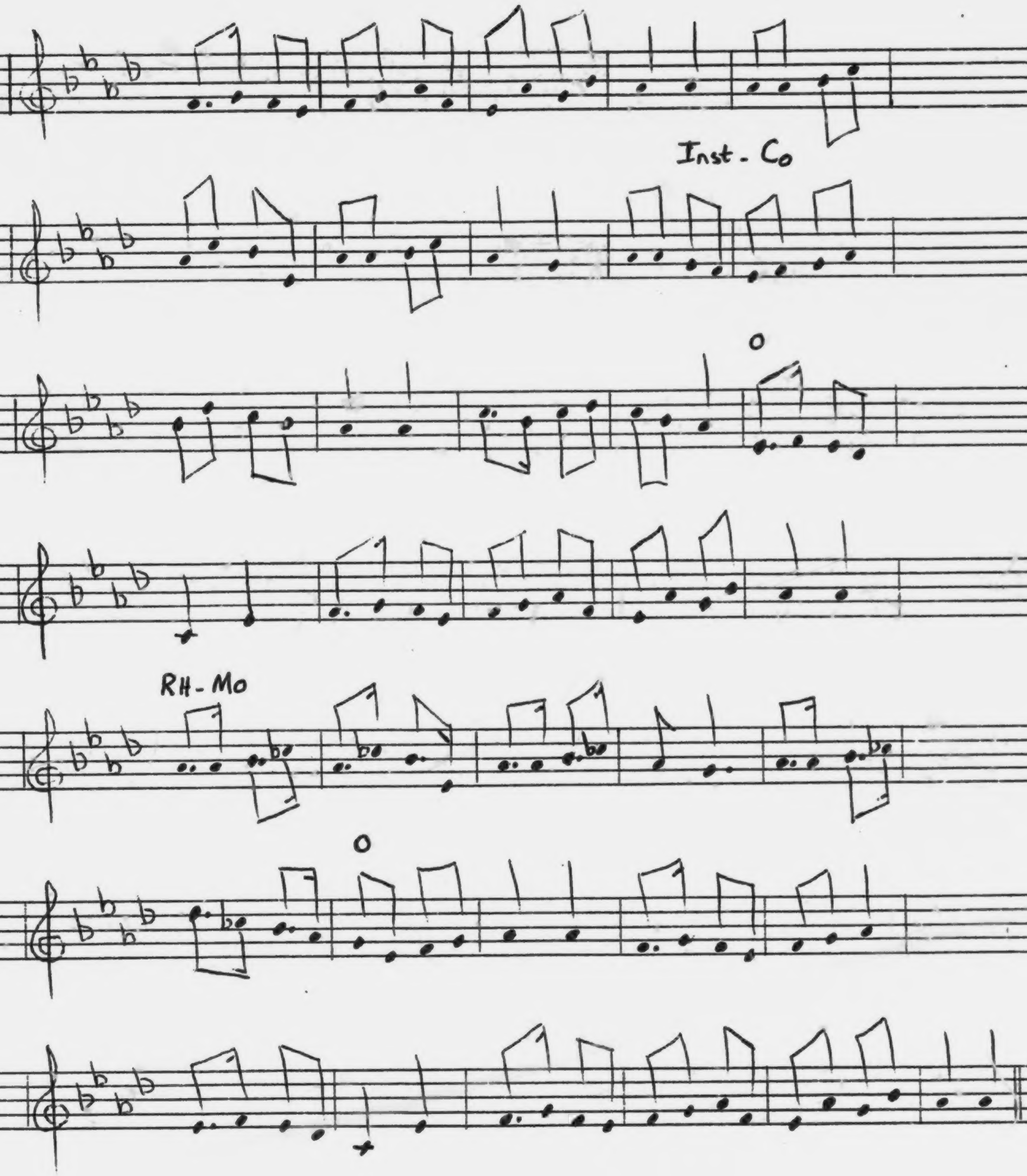

Ha-Co

Task III

♩ = 120 "Yankee Doodle"

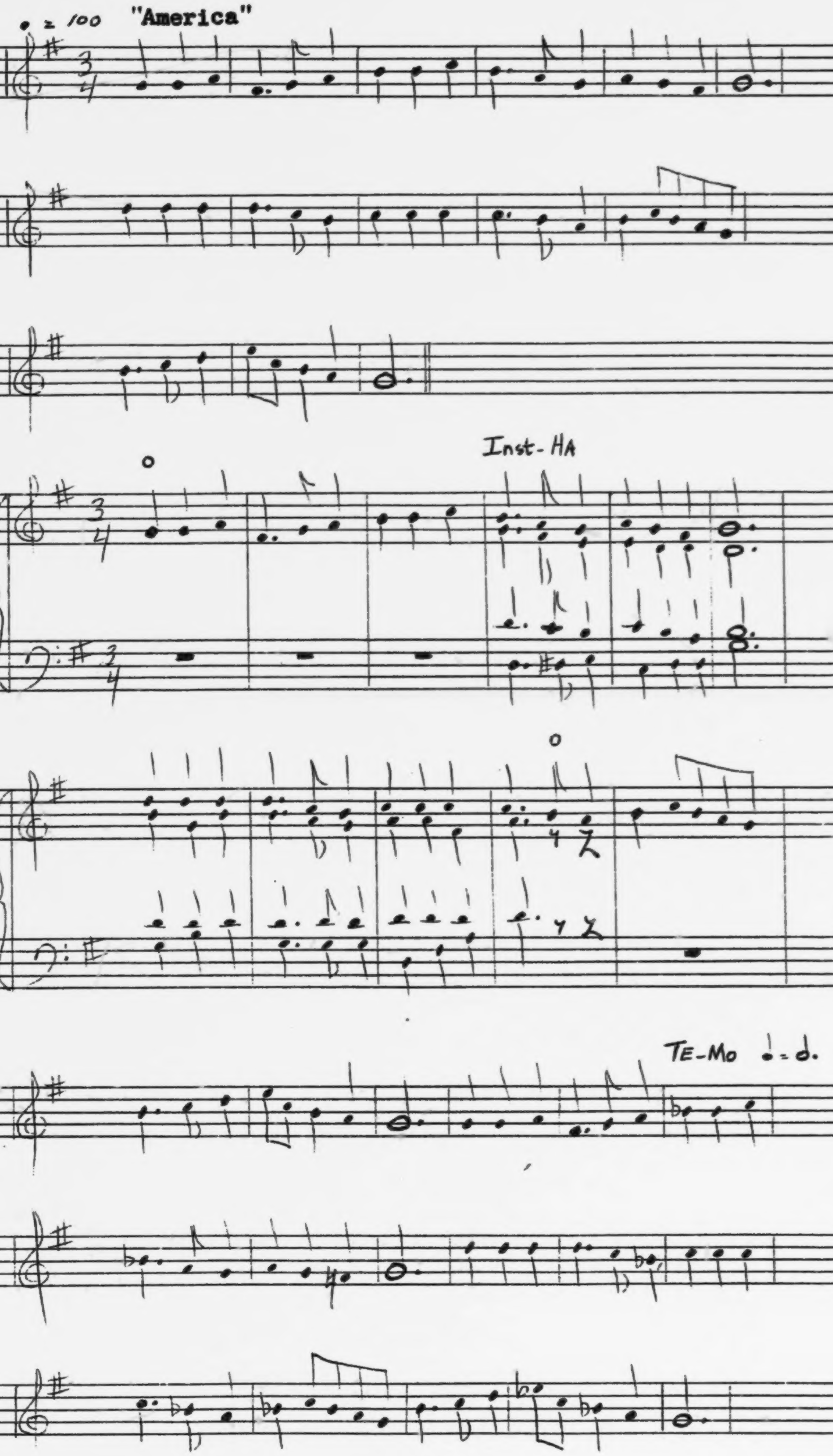


2/4
o
TE-HA
♩. = ♪
4/4
o
♪ = ♩
2/4
Diff.
o

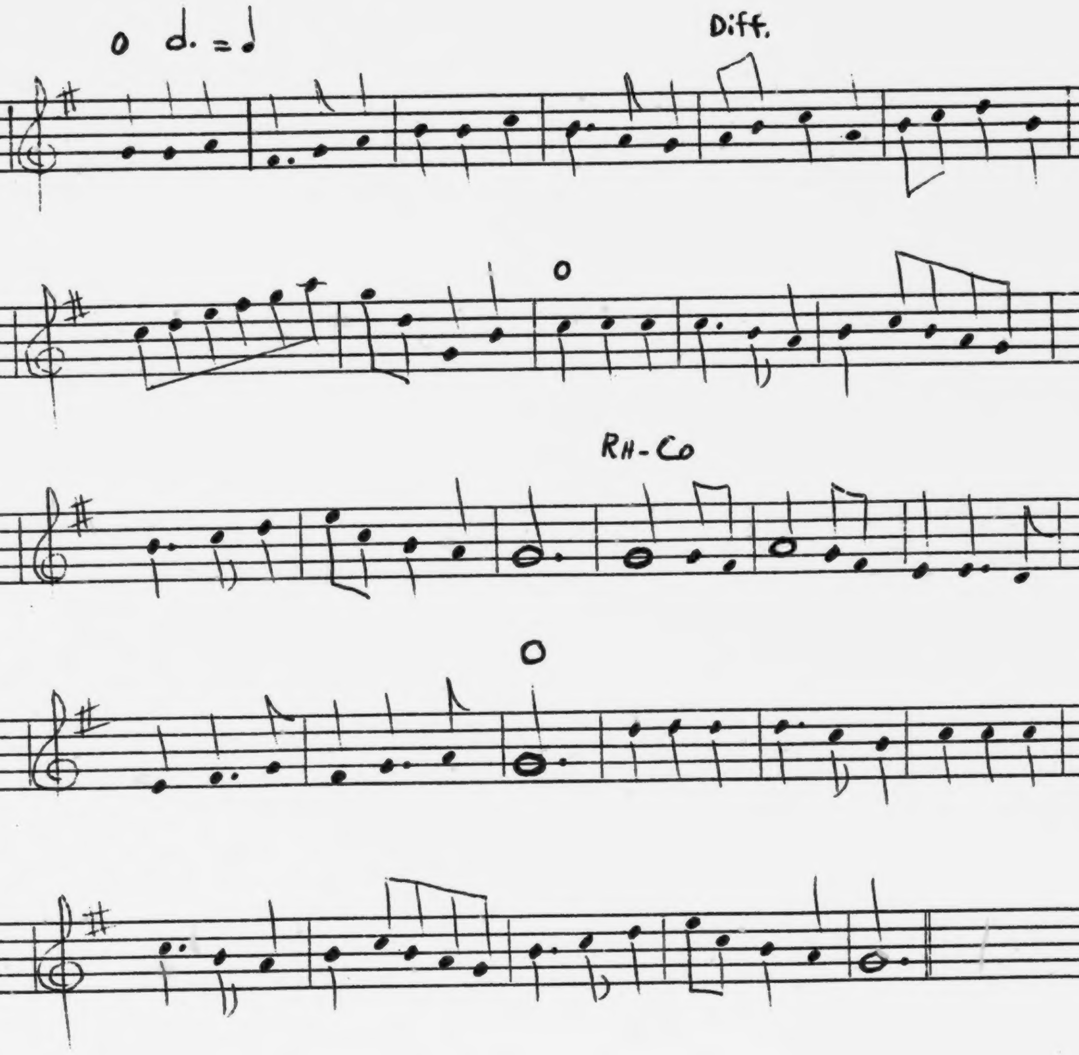

Inst - Co
o
RH - Mo
o

Task IV

"America"



♩ = 100
Inst-HA
TE-Mo ♩ = 𝅗𝅥.


o
𝅗𝅥. = ♩
Diff.
o
RH-Co
o

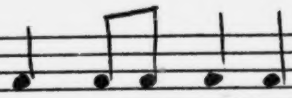
APPENDIX G

EXPERIMENT V

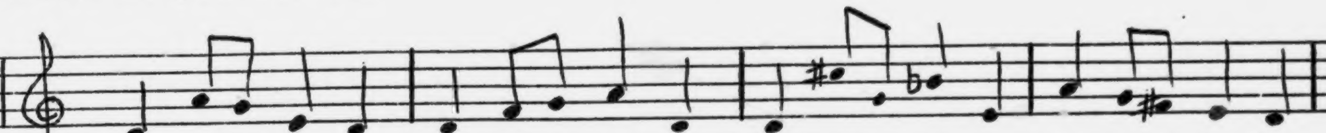
Conservation of Rhythm Pattern

Training Session

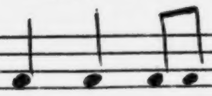
A rhythm pattern is an arrangement of long tones and short tones. Listen to this rhythm pattern.



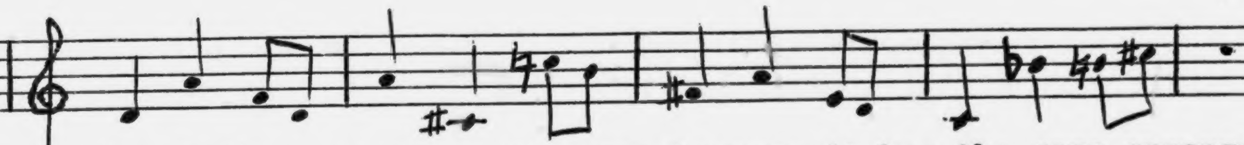
The rhythm pattern can also be played on different pitches. Clap the pattern as you listen.



The rhythm pattern is the same because it has the same arrangement of long tones and short tones. Listen to the second rhythm pattern.

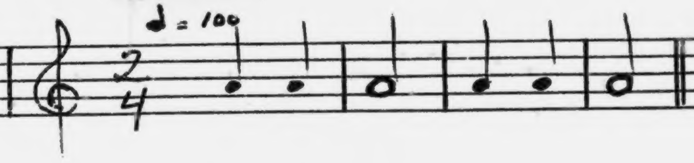


This rhythm pattern can also be played on different pitches.



Again the rhythm pattern is the same because it has the same arrangement of long tones and short tones.

Sample pattern (See instructions)
Standard



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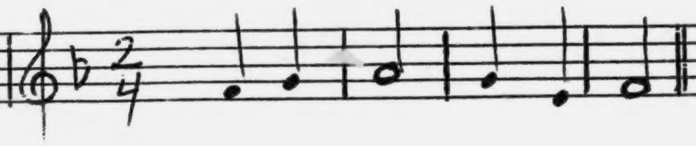

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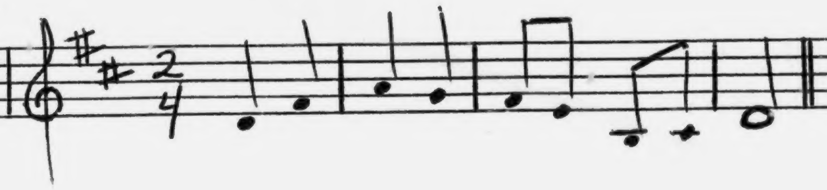

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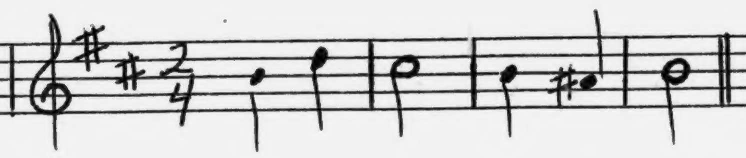

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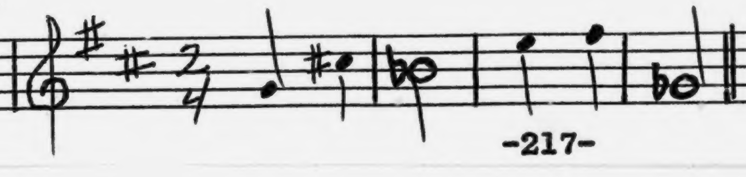
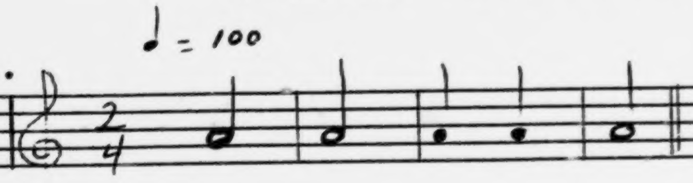


Conservation of Rhythm Pattern

1.



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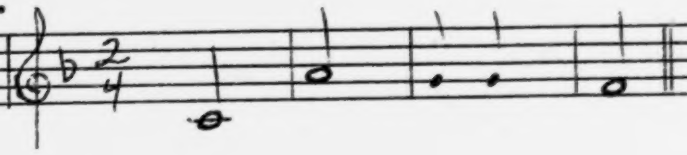

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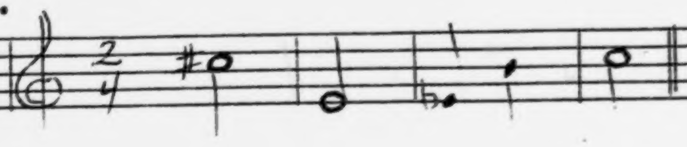

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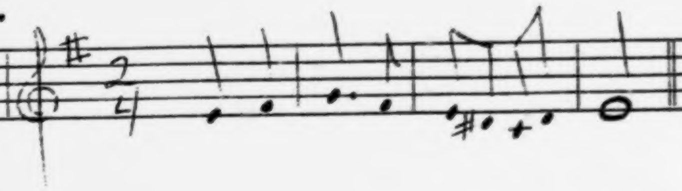

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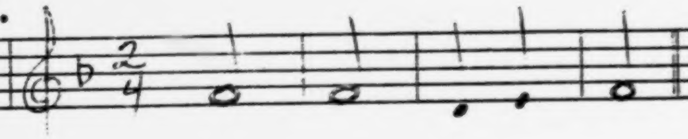

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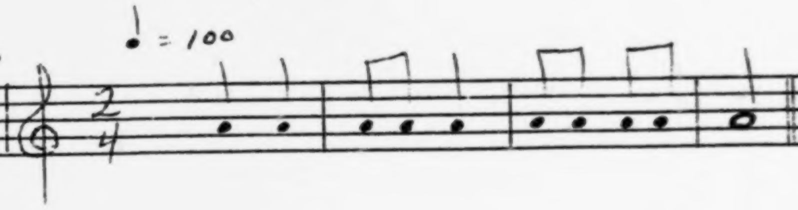

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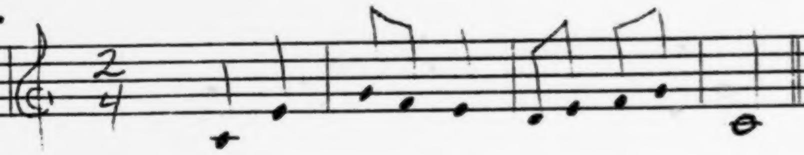

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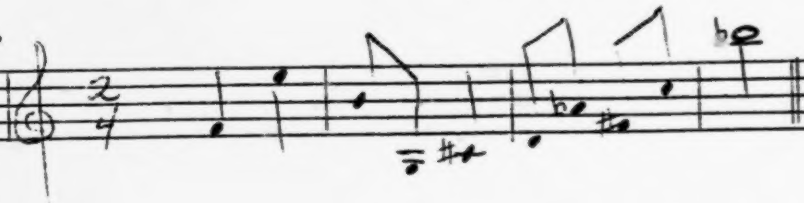

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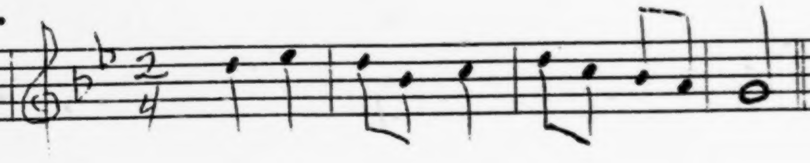

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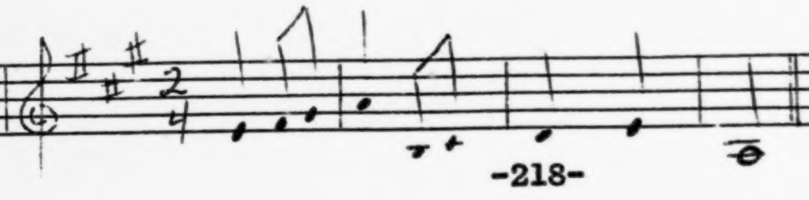

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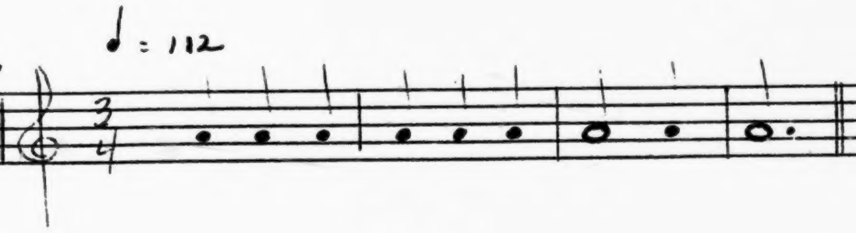

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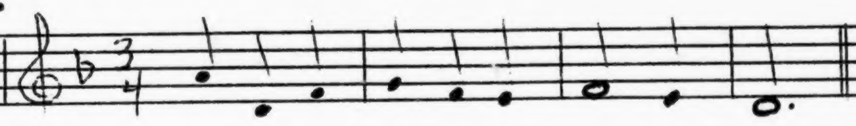

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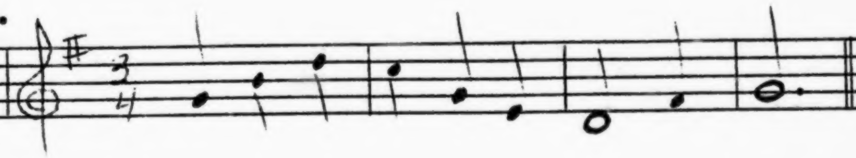

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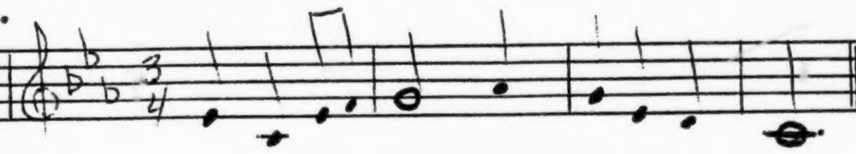

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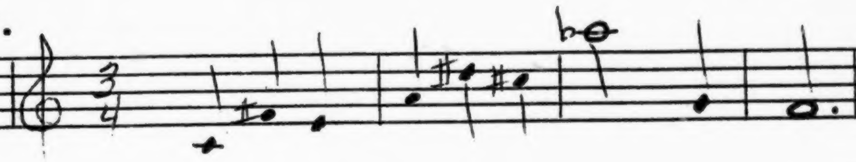

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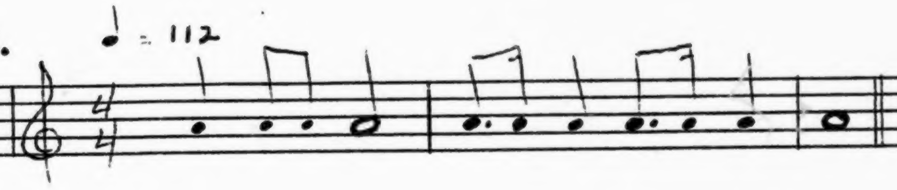

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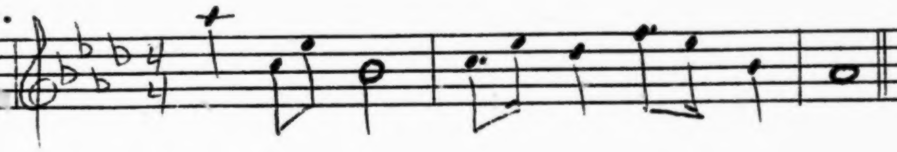

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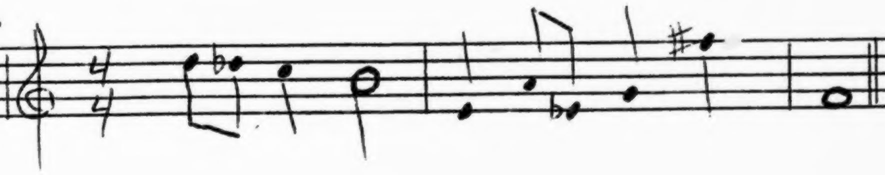

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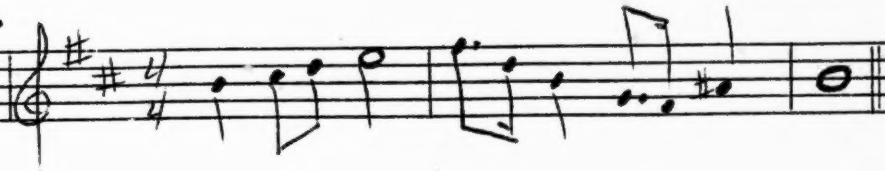

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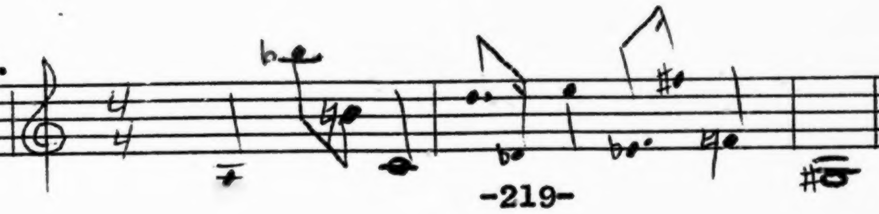

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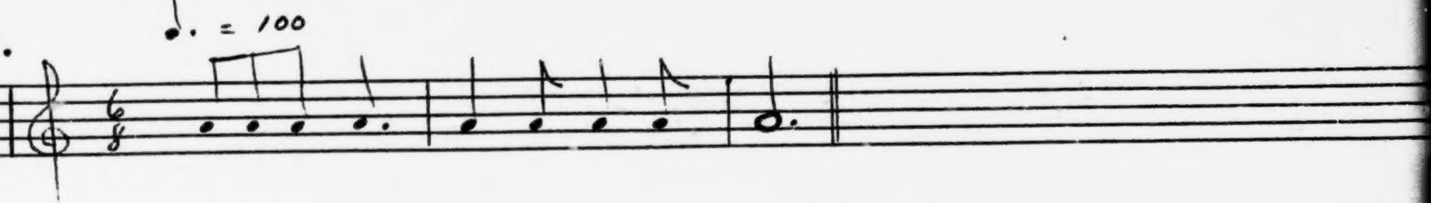

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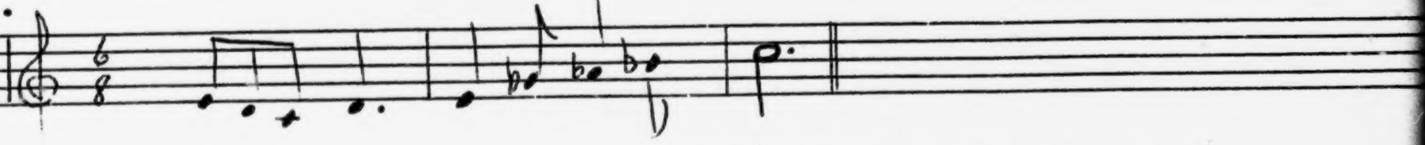

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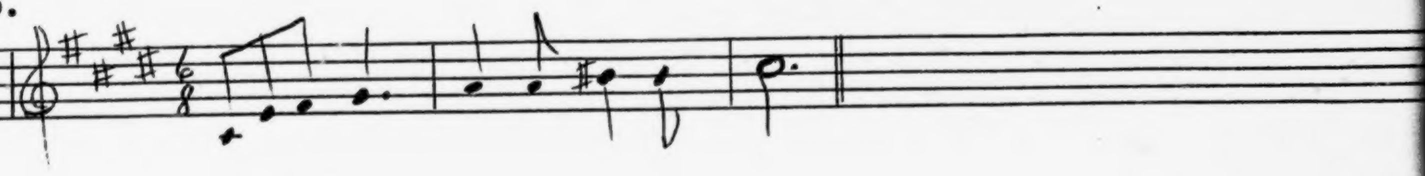

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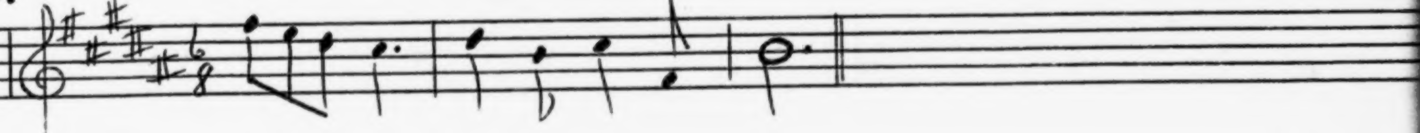

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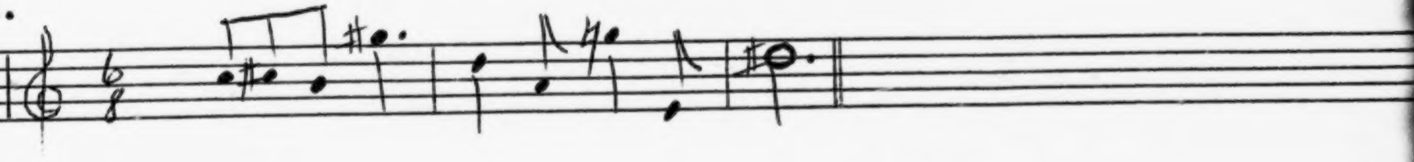

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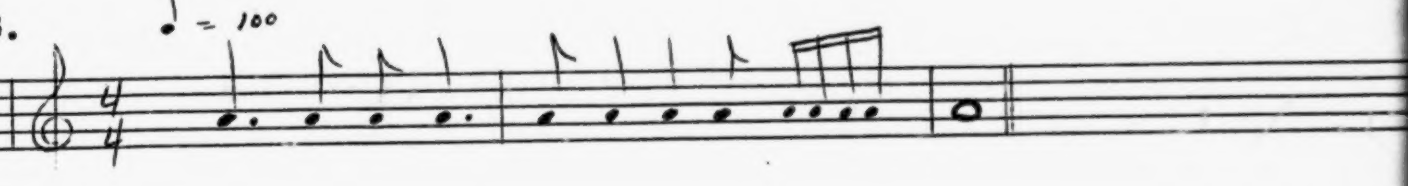

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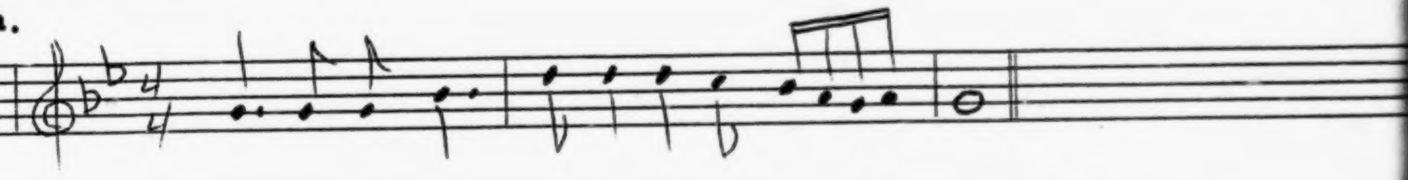

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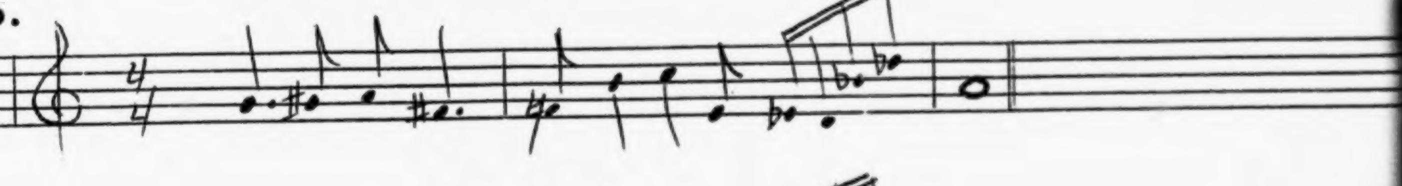

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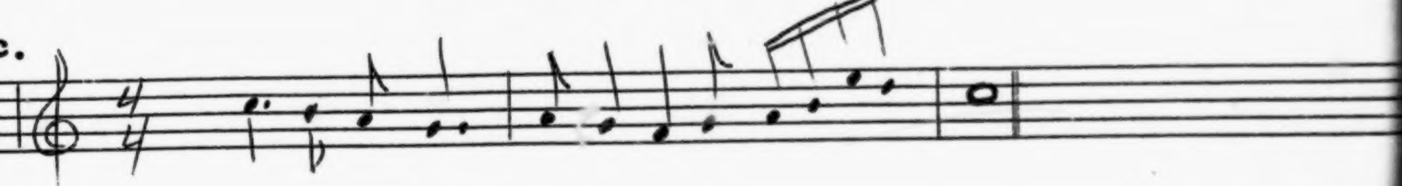

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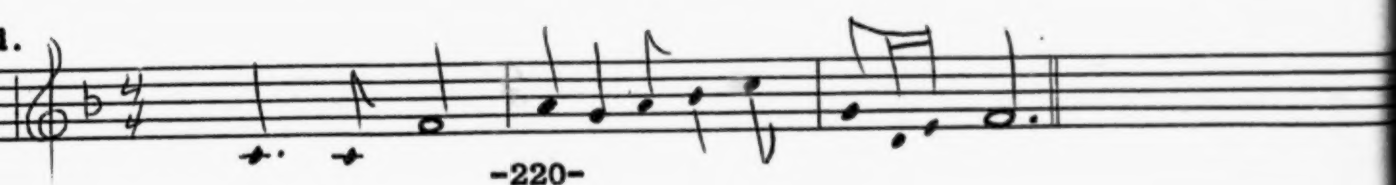
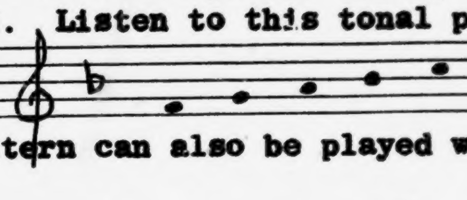
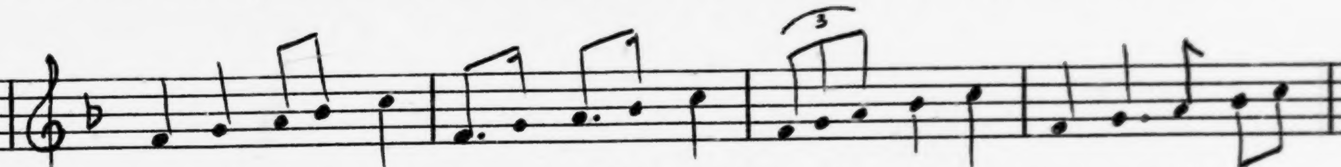


Conservation of Tonal Pattern
Training Session

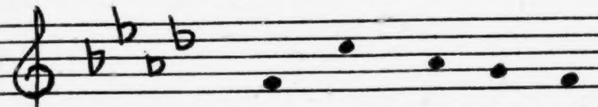
A tonal pattern is an arrangement of pitches. The pitches can be high or low or stay on the same pitch. The pitches can move up or down to make a tonal pattern. Listen to this tonal pattern.



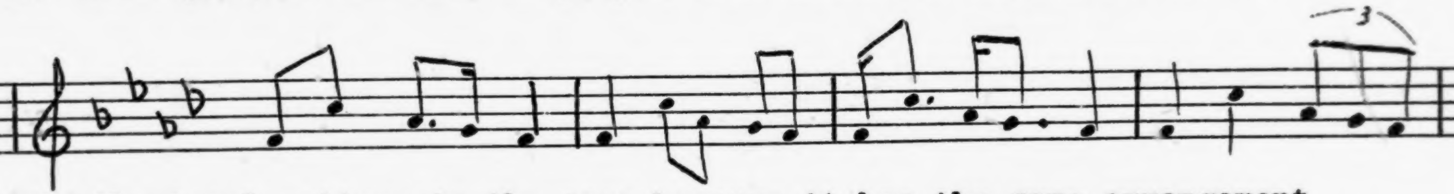
The tonal pattern can also be played with different rhythm patterns.



The tonal pattern is the same because it has the same arrangement of pitches. Listen to a second tonal pattern.

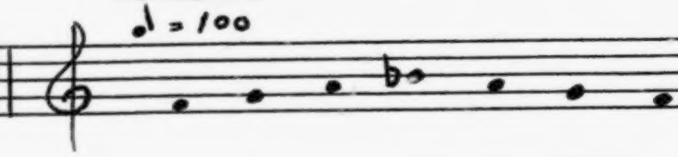


This tonal pattern can also be played with different rhythm patterns.



Again the tonal pattern is the same because it has the same arrangement of pitches.

Sample pattern (See instructions)
Standard



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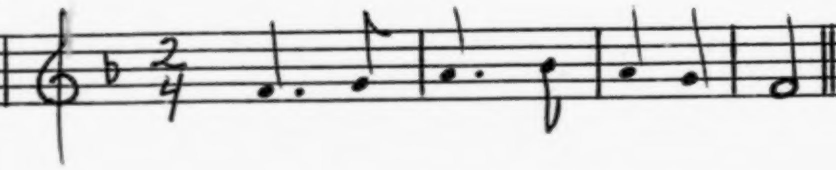

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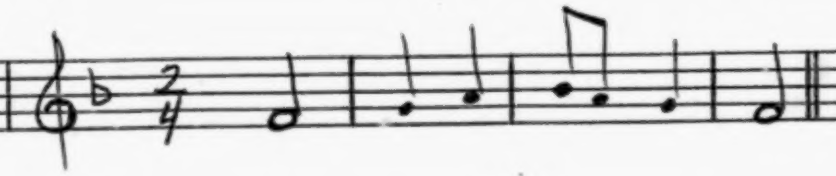

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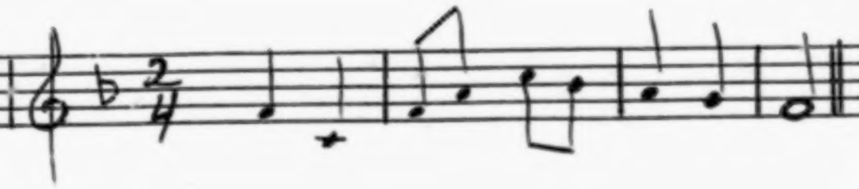

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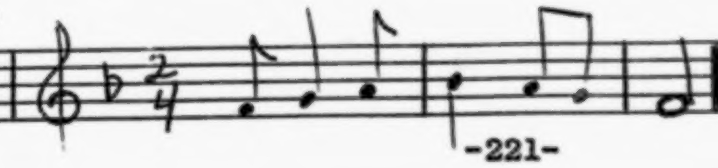

Conservation of Tonal Pattern

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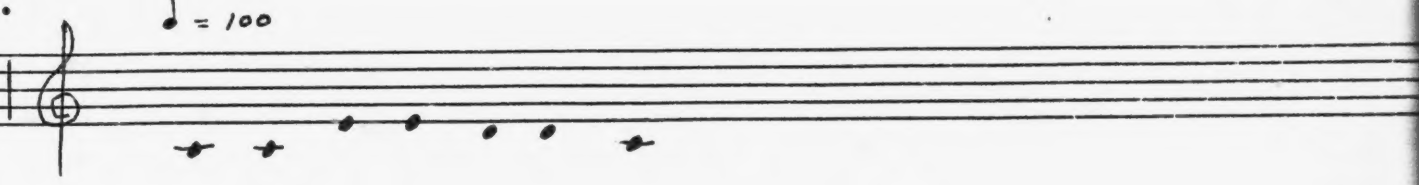

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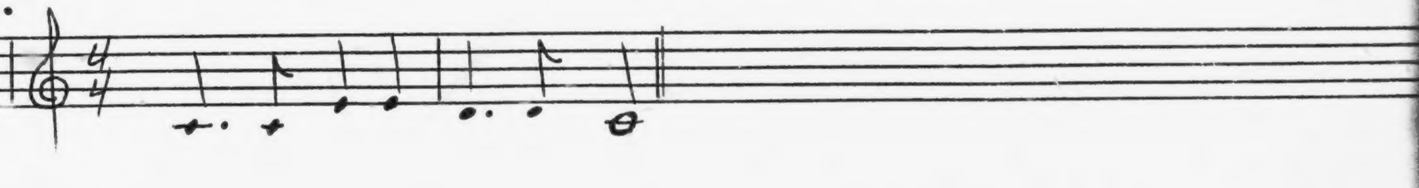

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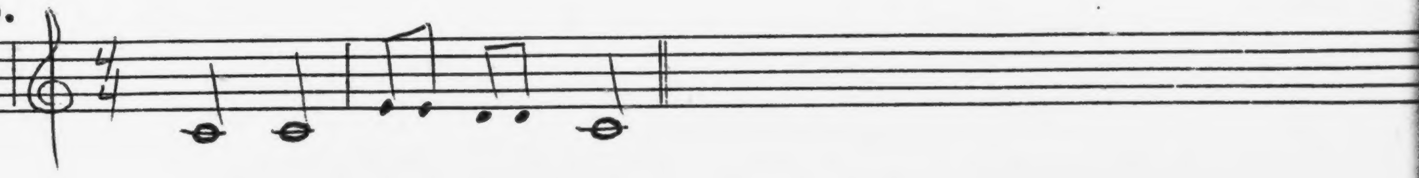

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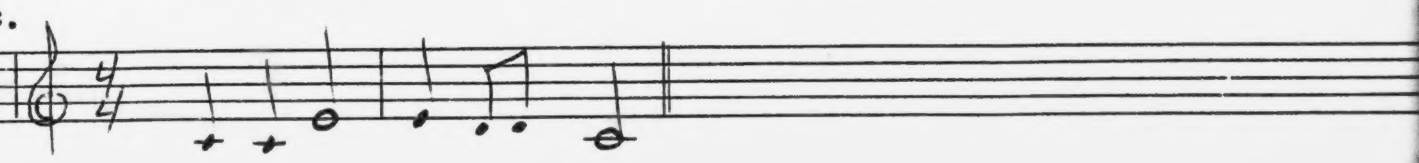

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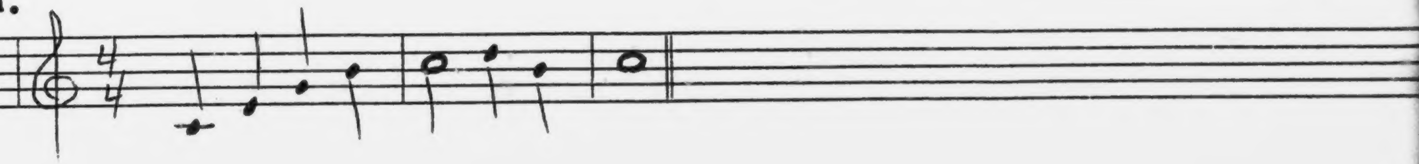

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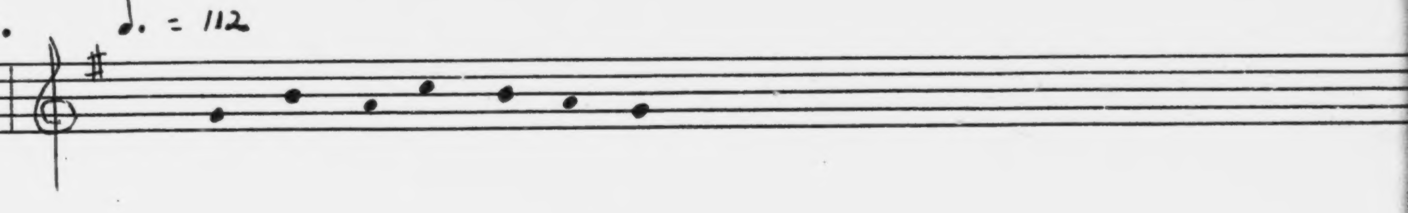

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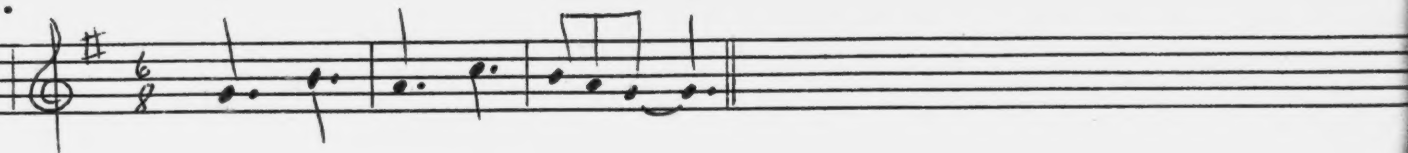

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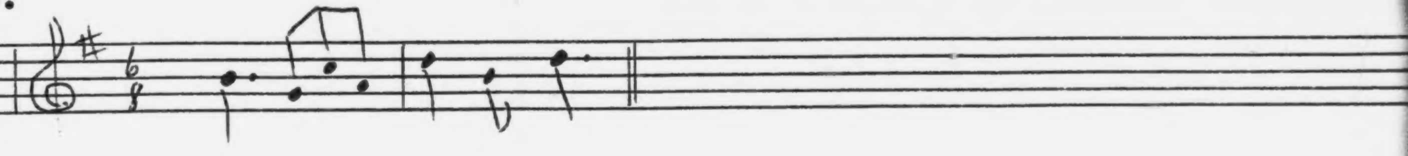

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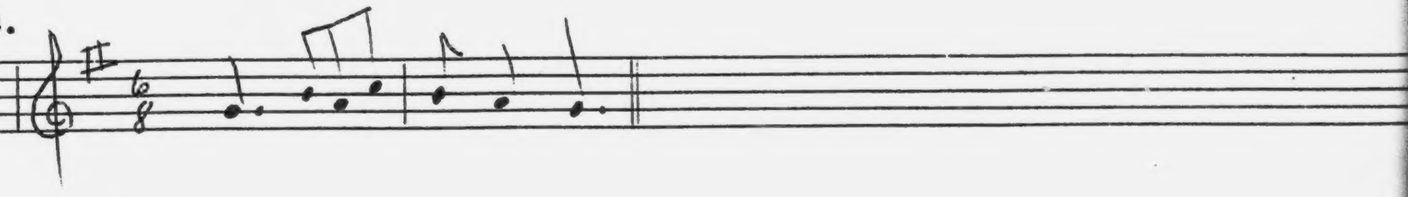

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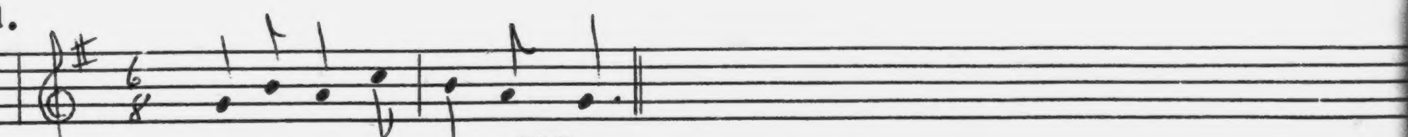

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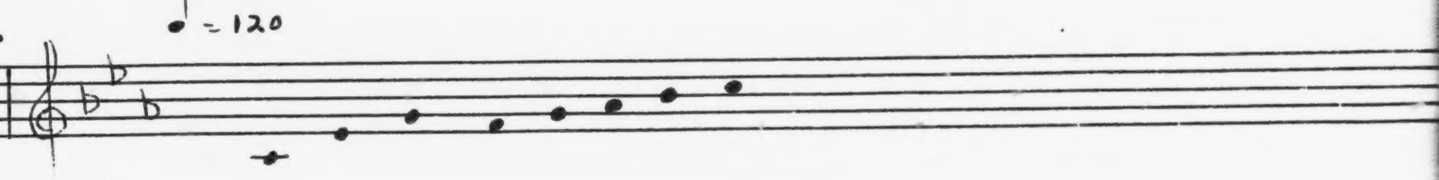

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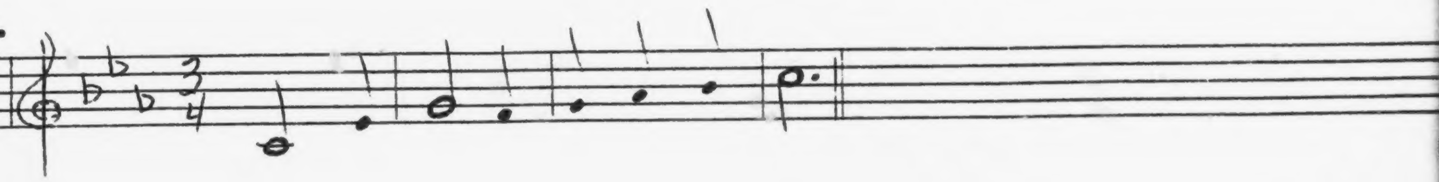

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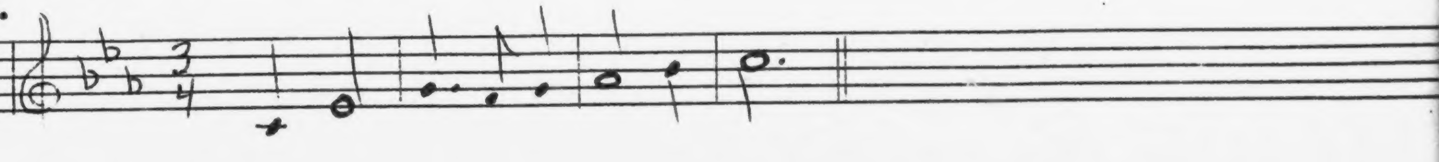

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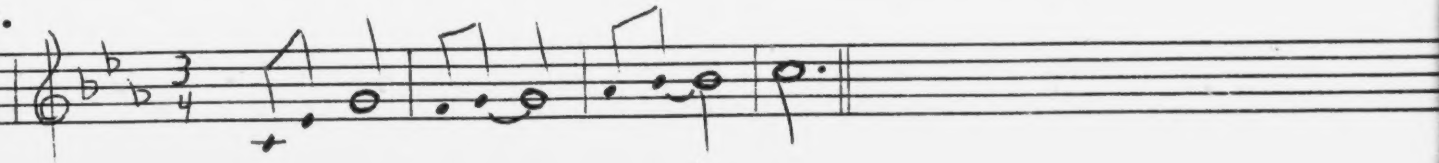

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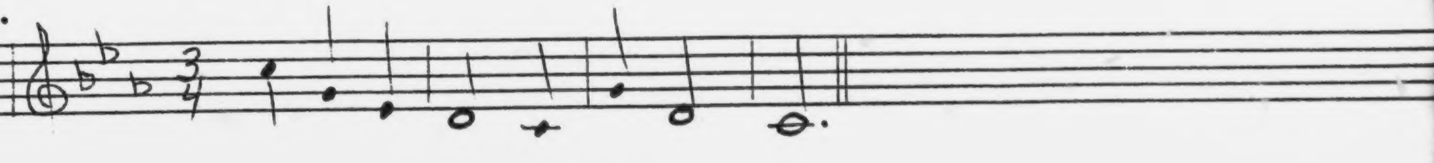

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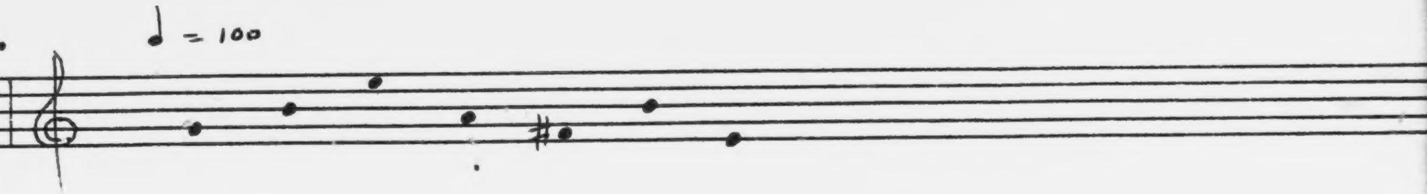

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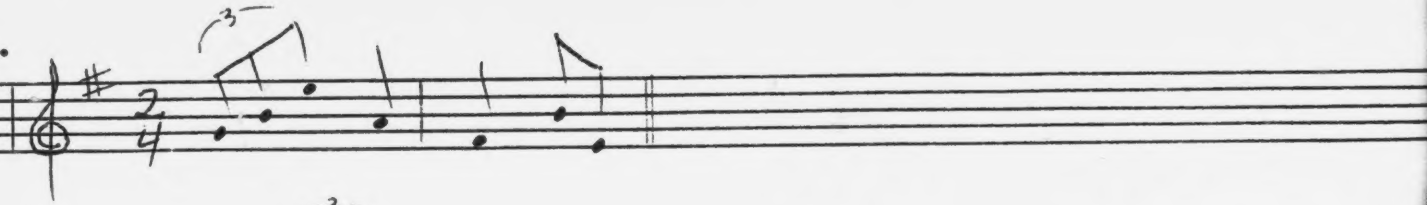

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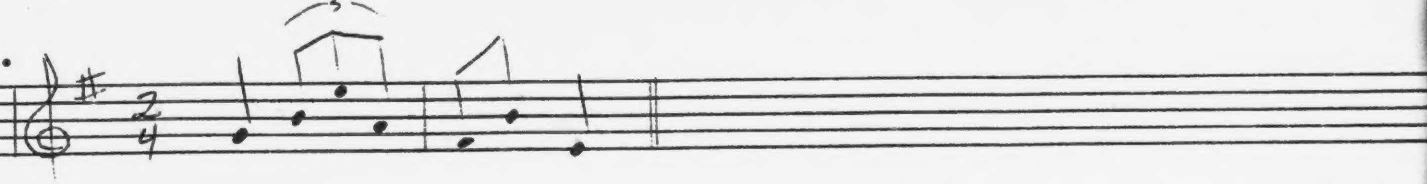

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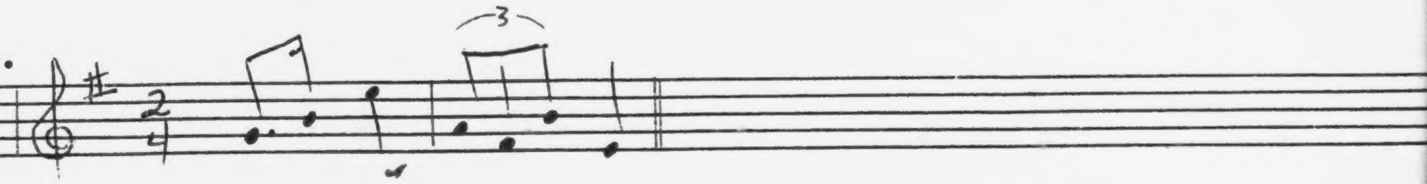

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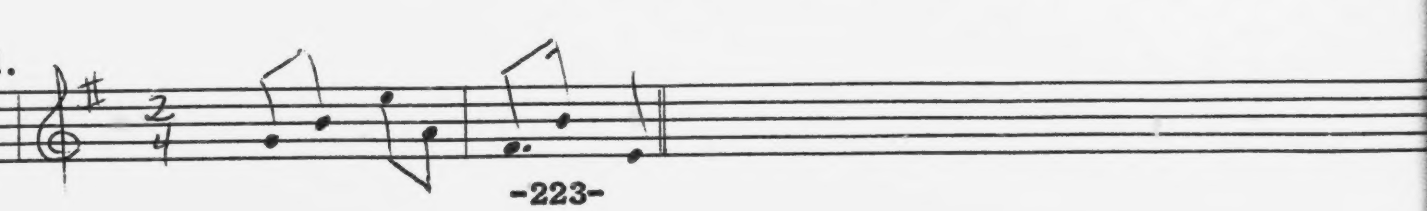

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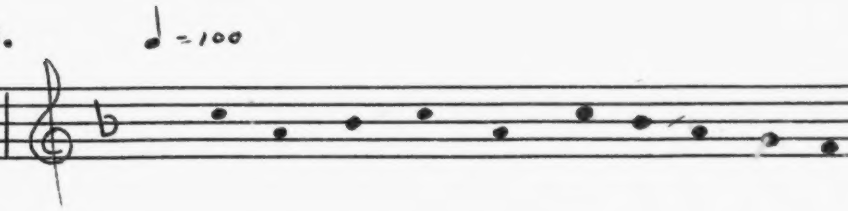

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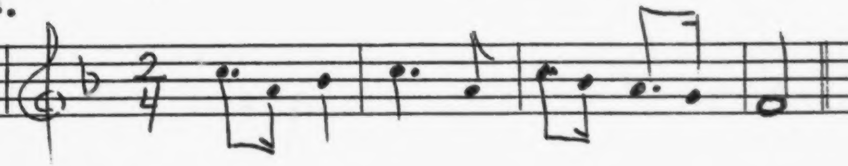

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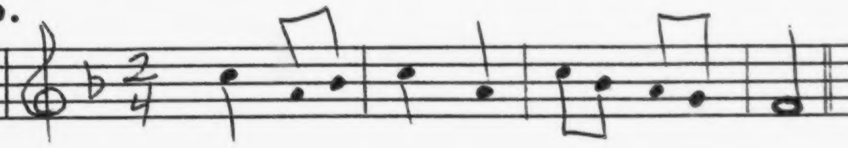

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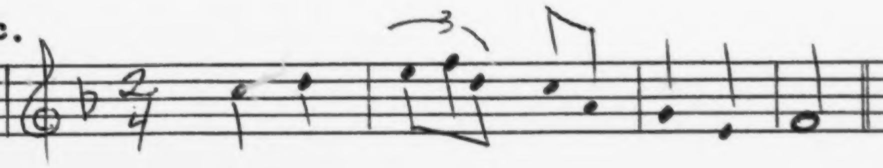

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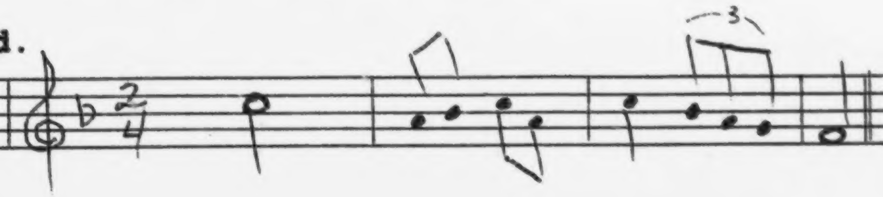

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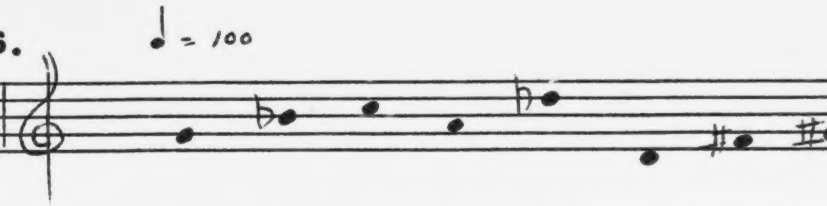

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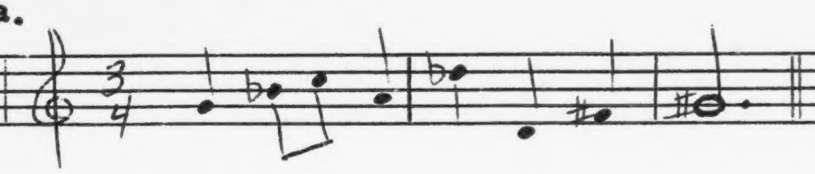

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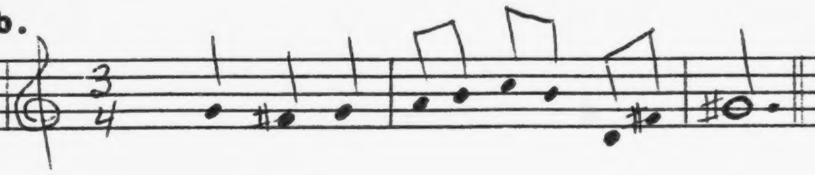

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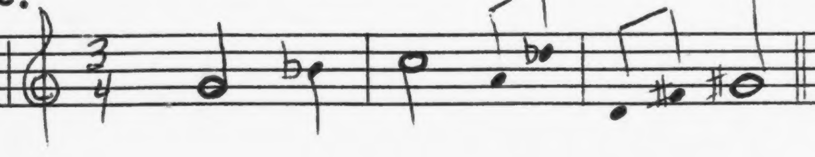

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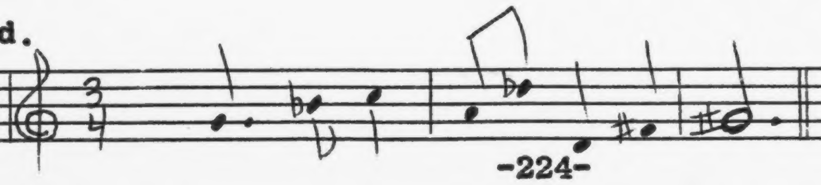


EXAMPLE OF SUBJECT'S COPY OF TEST
EXPERIMENT V

NORTHWESTERN UNIVERSITY

SCHOOL OF MUSIC

USOE 6-10-285

NAME____

AGE__________________ BIRTH DATE________________

GRADE__________________ROOM____________________

PRIVATE INSTRUCTION: YES______ NO______

Type of Instrument _________________

Years of Study____________________

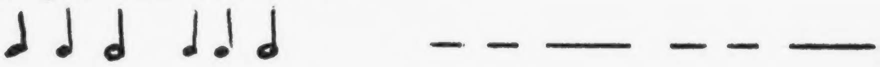
Test Series______________________

RHYTHM PATTERN

We will listen to six rhythm patterns. Each rhythm pattern will be played twice. Then it will be immediately followed by four musical examples. Listen to each example and decide if the rhythm pattern it uses is the same as the one you are using as a model. Then mark your answer on the answer sheet. If you think the pattern is the same, put an ☒ in the square beside the word "same". If you think the pattern is different, put an ☒ in the square beside the word "different".

Here is a sample pattern for practice.

SAMPLE



a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

You should have put an ☒ in the square beside the word "same" in examples a, c, and d, because in these examples the rhythm pattern is the same as the model. You should have put an ☒ in the square beside the word "different" in example b, because in this example the rhythm pattern is different from the model.

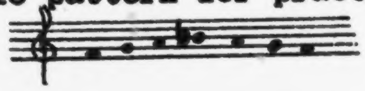
Now we will listen to the six rhythm patterns. Remember you will hear each pattern played twice at the beginning. Follow along on your answer sheets and mark the answers you think are correct.

TONAL PATTERN

We will listen to six tonal patterns. Each tonal pattern will be played twice. Then it will be immediately followed by four musical examples. Listen to each example and decide if the tonal pattern it uses is the same as the one you are using as a model. Then mark your answer on the answer sheet. If you think the pattern is the same, put an ☒ in the square beside the word "same". If you think the pattern is different, put an ☒ in the square beside the word "different".

Here is a sample pattern for practice.

SAMPLE



a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

You should have put an ☒ in the square beside the word "same" in examples a, b, and d, because in these examples the tonal pattern is the same as the model. You should have put an ☒ in the square beside the word "different" in example c, because in this example the tonal pattern is different from the model.

Now we will listen to the six tonal patterns. Remember you will hear each pattern played twice at the beginning. Follow along on your answer sheets and mark the answers you think are correct.

Rhythm Series A

1.

a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

2.

a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

(etc.)

Tonal Series A

1.

a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

2.

a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

(etc.)

Rhythm Series B

1. —— —— — — ———

a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

2. — — - - — - - - - ————

a. ☐ same
☐ different

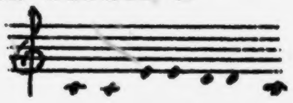
b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

(etc.)

Tonal Series B

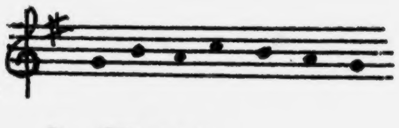
1.


a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

2.


a. ☐ same
☐ different

b. ☐ same
☐ different

c. ☐ same
☐ different

d. ☐ same
☐ different

(etc.)

APPENDIX H

A Note on a Classroom Application of Pflederer-Sechrest Research (Musical Tasks from Experiments II, III, IV)

Retha Jane Mason

It is not unusual to find junior college students who enter college with very little previous contact with serious music. The students who have had little or no experience with music literature have some difficulty in learning to listen. Experience is an essential ingredient for listening. The problem which is presented to junior college teachers is one of helping the student to bridge the gap in experience. A way must be found to bridge that gap quickly and effectively.

When patterns of sound are once apprehended they must be understood and remembered so that they may be recognized as they appear in different contexts of rhythm, melody, harmony, and tone color. Concepts of diminution, augmentation, inversion, retrograde motion, etc., are most easily comprehended in music which has been a part of the student's experience. The original musical idea can be "conserved" as alterations take place because it is a part of a long time experience. The aesthetic principle of repetition and contrast can be genuinely understood only when patterns of sound are recognized and understood in all their transformations.

The one area which is often neglected in teaching music literature is that of teaching music to non-music majors. Professional musicians need educated audiences if the art is to exist on a high level. And perhaps even more important, an individual enjoys a more intense emotional satisfaction from music if he also derives intellectual satisfaction from listening. We owe this opportunity to our students.

The above ideas form an important part of my philosophy of teaching music literature to non-music students in humanities or in music appreciation classes. It was my firm conviction that these principles do operate that led me to use familiar tunes such as "America" and "Twinkle, Twinkle, Little Star" to introduce musical materials to these classes. Since composers of some stature (Mozart, Beethoven, etc.) have written compositions using these tunes, it was convenient to work from the familiar to the unfamiliar.

When I read about Dr. Pflederer's experiments with children, I contacted her and requested more information about the tasks she used with children in listening. I was fascinated with her similar approach and with the thoroughness of her investigative procedures. I indicated that if the tasks worked well for little children, they might be useful in helping adults to bridge the gap in experience if the concepts were thoroughly understood. She generously gave me copies of the tasks used in the experiments at Northwestern.

The response of adult students to these tasks has been so positive that I am led to believe that they may be a useful tool in bridging the experience gap. Adults, unlike children, are able to make intuitive leaps in their listening experience which can carry these experiences to more sophisticated levels rather rapidly. Boys in music appreciation classes suddenly perked up and declared that they were really understanding what music was about. The tasks also helped them to make sense out of compositions which were studied later in the semester.

In another class which consisted of adult members who taught elementary music the tasks were introduced in a demonstration after a number of students described their experiences in teaching listening to elementary students. The teachers were approaching the music mainly through anecdotes and extramusical ideas. "The boys," they said, "were bored. How much could these children be expected to understand?" I suggested that the children were able to recognize elements of music and that it might become an interesting challenge for them to be required to do so. I introduced the Pflederer tasks in a demonstration to the class and found the teachers themselves, enthusiastic and discovering some new insights.

A few weeks later two teachers reported to the class that their experiences at school had changed since they were introducing their students to patterns of sound and identifying the elements as they appeared. The boys had become enthusiastic participants in the class.

Similar tasks are also useful in ear training courses and courses in music fundamentals for classroom teachers. What is needed is an opportunity to experiment with these materials with large numbers of students in humanities classes, music appreciation classes, and with other groups of non-music majors.

My experiences indicate a positive response but more valid information could be made available if materials which would trace the music patterns from simple to more complex tasks could be prepared for large-scale use in classes at the college level. It might then be possible to determine just how valid this method would be in bridging the experience gap.

If the Pflederer-Sechrest experiments prove that children are able to conserve a musical idea which they experience often enough, than a logical next step would be to provide adults with opportunities to build upon their experience no matter how limited. Since this is a major problem faced by mass education, the results could be far-reaching and might well be applied to other areas of learning.

Music Department

Prairie State College
Chicago Heights, Illinois